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MAY 15, 1942

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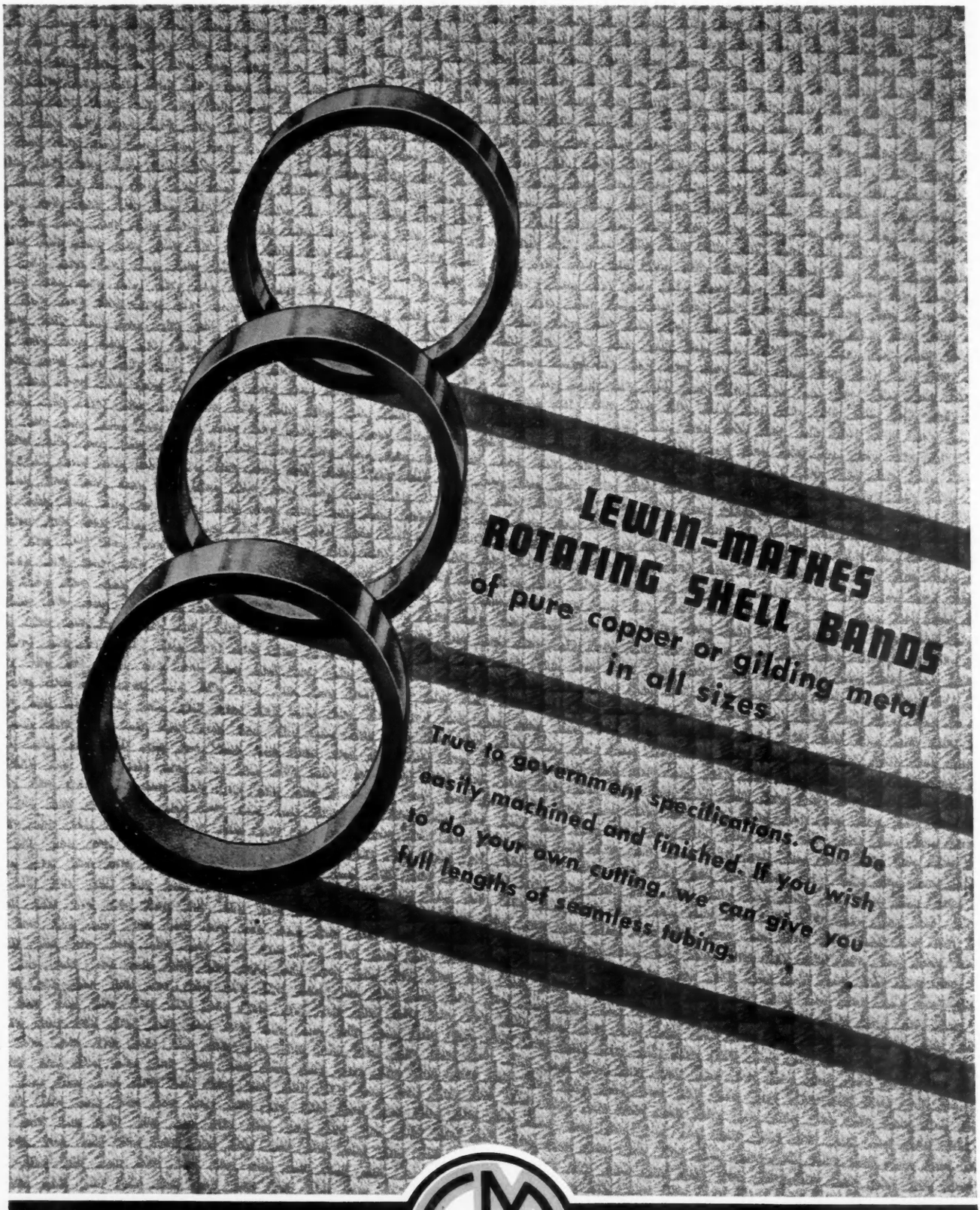

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AUTOMOTIVE and AVIATION INDUSTRIES

Volume 86 May 15, 1942 Number 10

British Defiant Night Fighter 18

Almost daily over the Channel goes a cordon of R.A.F. planes. Among them are a goodly number of Defiant models. How these comparatively small planes "can take it" shows up in the description given in this article of their construction and its power-operated gun turret.

German Warplane Construction 20

In this article the author makes a comparison of the types of construction in the German planes and those of the Allied Nations. Complete with pictures and drawings one is taken from one element to another through many of the parts that go to make up a complete flying war tool.

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Conveyor System in the Martin Plant 30

Of paramount importance in the speedy production of wartime materiels is the transportation of parts from one operation point to the next with a minimum of time and handling. What has been accomplished at the Martin bomber plant is enlightening.

Subcontracting in War Production Program 36

The extent to which the services of subcontractors are being used in our all-out program is revealing. The number of parts that involve some of the complete assemblies and the number of suppliers of these parts is surprising. You should read this to learn just how this big job is being handled.

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Here is some data on the enemy engines of war that opens up a new understanding of the war. Keep this at hand for reference.

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Lift Truck Restrictions

Five States recently have suspended drastic truck laws and regulations which have been impeding the movement of persons and goods over highways. During the last 18 months more than 20 States have liberalized their laws to meet the expanding highway transportation needs of the nation in its war effort.

The Governor of Iowa has suspended provisions of the truck laws to permit vehicles to haul larger loads. Discriminatory weight restrictions on out-of-State vehicles also were eliminated. Under the new regulations, a maximum load limit of 18,000 lb. per axle is permitted for all trucks. In Tennessee the maximum load limit has been raised from 30,000 to 41,500 lb. The Alabama gross weight limit, one of the lowest in the nation, has been raised to 40,000 lb. for the transportation of many essential products. Nearly 1000 trucks have already obtained permits to operate under the higher load limit. Oregon has upped the gross weight limit to 68,000 lb. And South Dakota has suspended its regulation forbidding the operation of tank trucks on Sundays and holidays.

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 86, No. 10
May 15, 1942

Replacement Parts Schedule

as Authorized by WPB's New Limitation Order

By E. L. Warner, Jr.

TAKING a more realistic view of the problem, the Automotive Branch of the War Production Board, in its curtailment of the manufacture of replacement parts to place such manufacture more in line with the increasingly restricted materials situation, has extended the period for the production of such parts by three months to Sept. 30. Under the new limitation order, which was issued May 5, manufacturers of functional replacement parts for passenger cars, station wagons, taxicabs and light trucks under 9000 lb. gross vehicle weight, are limited in the production of such parts to 70 per cent of the total dollar volume of such parts sold in the corresponding quarter of 1941. Manufacture of all non-functional parts such as fenders, hoods, bumpers and running boards is banned. The new order extends from April 1 and covers the quarters ending June 30 and Sept. 30.

The new limitation order L-4-c supersedes L-4-2 and L-4-a, which permitted manufacturers to make 150 per cent of their total 1941 sales volume of replacement parts in the first six months of 1942, making it equal to a 300 per cent increase over the 1941 going rate of output in the first half of 1942. Although manufacturers had been allowed this high rate of production, very few of them had been able even to approach their quotas in the early months of 1942 due to the inability to obtain materials. The A-10 priority rating for passenger car replacement parts was virtually useless in trying to obtain such critical materials as steel, copper, tin and rubber. Only 16 of 103 parts companies queried by the Motor and Equipment Manufacturers Association in a recent survey expected to produce 50 per cent or more of their quotas in the six-month period.

The original order L-4-a was designed to build up a supply of replacement parts to keep the nation's 28 million passenger vehicles in operation during 1942 and 1943. The high rate of production was limited to the first six months of 1942 because it was anticipated that the men and machinery might be required for war production after the June 30 deadline. However, a survey of the conversion of the automotive industry to war work by the WPB revealed that parts production facilities probably will not be completely taken over by war production. Therefore, it was decided to allow the parts industry to continue the manufacture of functional replacement parts until Sept. 30 at a low rate, the attitude being that this would not interfere with the war effort and it would provide a larger stock of parts to draw upon to "Keep 'Em Rolling" in late 1942 and in 1943.

The 70 per cent of 1941 production allowed is more in line with the facts than the 300 per cent rate permitted in the previous order. A recent informal caucus of passenger car producers showed that most of them were turning out replacement parts at 25 to 60 per cent of their allowed quotas for the first half of 1942. In the parts field only one producer, a maker of brake linings, expected to fill his 150 per cent quota for the six-month period.

The new order also is designed to maintain a better balance in stocks and inventories. During the third month in each calendar quarter, June and September, a produced is prohibited from having a dollar value inventory of finished parts exceeding four times his average monthly sales during the preceding calendar quarter. Thus companies that were able to produce at a high rate during the early months of 1942 probably will have to curtail or cease parts production in the third quarter of the year due to this inventory limitation. Manufacturers also are restricted as to their raw materials and

(*Turn to page* 41, *please*)

Functional Replacement Parts for Passenger Cars, Station Wagons, Taxicabs, and Light Trucks (under 9000 lb GVW) Authorized by WPB for Production.

- Engines
- Clutches
- Transmissions
- Propeller Shafts
- Universal Joints
- Axles
- Brakes
- Wheels
- Hubs
- Brake Drums
- Starting Apparatus
- Spring Suspensions
- Shock Absorbers
- Exhaust Systems
- Cooling Systems
- Fuel Systems
- Lubrication Systems
- Electrical Systems, including generators, lights and reflectors
- Gages
- Speedometers
- Rear View Mirrors
- Windshield Wipers and Motors
- Control Mechanisms
- Steering Apparatus

British Defiant Night

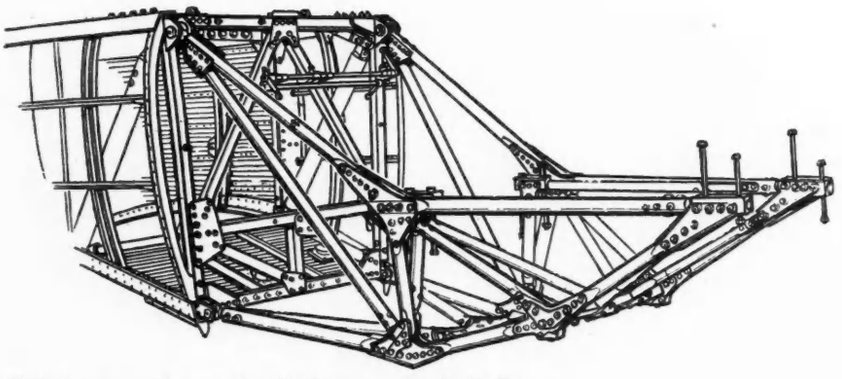
By M. W. Bourdon
Special Correspondent of Automotive & Aviation Industries in Great Britain.

With a speed around 300 m.p.h. at 16,500 ft., the British Defiant two-seat fighter is said to be the first aircraft of its type with a power-operated gun turret to be adopted by any Air Force in the world. Details of the constructional features of this machine were published recently in England, though it has been in use by the Royal Air Force for some time, employed chiefly as a night fighter. The underlying purpose of its design lies in its armament, which is found solely in the hydraulically operated turret located at the rear of the cockpit. In it are mounted four .303 in. Browning machine guns. The field of fire, even forward, is sufficient to justify dispensing with other armament. All guns are, therefore, operated by the man in the turret-enclosed rear cockpit.

Here it may be mentioned that the manufacturer of the Defiant, the Boulton Paul Aircraft Co., was the pioneer of the power-operated rotating gun turret. In one of the accompanying photographs it is shown in a Blackburn Roc in the same position as on the Defiant.

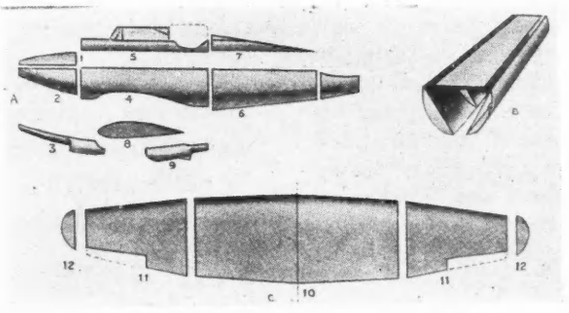
As with the Hurricane and the Spitfire fighters, the latest Defiant has a much improved performance. The engine is now a Rolls-Royce Merlin III developing 1030 hp. at 16,500 ft., which gives it a power loading of 7.28 lb. per hp., the weight of the aircraft being approximately 7500 lb. For a two-seater, it is a small machine, with its wing span of 39 ft. 4 in. and wing area 250 sq. ft. less than those of the Hurricane. In further comparison with the latter, the Defiant wing-loading of 30 lb. per sq. ft. is 4 lb. per sq. ft. greater. The over-all length of the Defiant is 35 ft. 4 in.

The wings consist of five units from the constructional viewpoint—a center section, two outer panels and two detachable tips. Straight lines are preserved where possible as an aid to rapid production. In thickness, as well as in plan, the three major units are formed with straight-line tapers. The leading edge

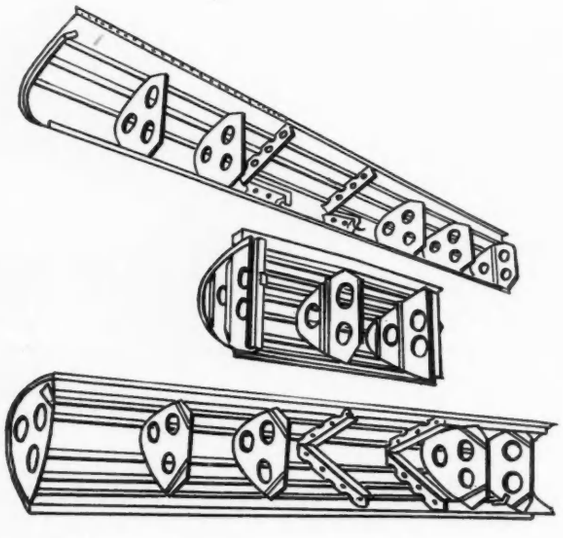


Tubular mounting of the Defiant for the Rolls-Royce engine.

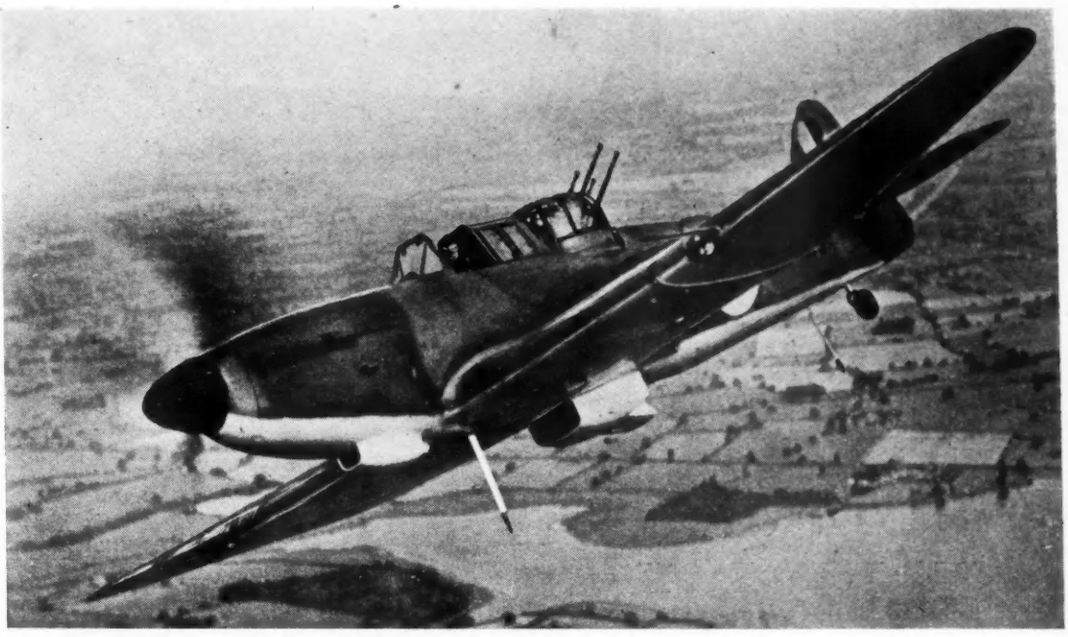
Illustrations of construction details by courtesy of Aircraft Production (England)



Breakdown of the Defiant structure into separate assembly units.



Left—Internal construction of the detachable leading edges of the center and outer wing sections. A D-section tube is formed by them in conjunction with the front spar. The D-section construction also is employed for the nose of the ailerons, elevator, stabilizer and rudder.



Latest Boulton Paul Defiant night fighter with hydraulically operated four-gun turret. The fairing back of the turret is in the lower position.

Fighter

First Fighter with an enclosed power-driven turret

consists of light alloy sheet, shaped in a Pels bending machine and secured to light alloy formers. The center wing section encloses two leakproof fuel tanks and the inwardly retracting under-carriage is hydraulically operated and fitted with Lockheed Airdraulic shock absorbers. The tail wheel on the current production model is not retractable.

Hydraulically operated split flaps extend along the trailing edge of the wings and have a width equal to 18 per cent of the chord. They are interrupted below the fuselage, where they would otherwise interfere with the air flow into the intake cowling below the radiator, for the latter is located unusually far aft. The air intake for the oil cooler and the carburetor is

(*Turn to page* 70, *please*)

Blackburn Roc fighter with four-gun turret like on the Defiant. Note the position of the fairings fore and aft of the turrets. On the lower plane they are shown in position for action and on the upper plane in the flight position to reduce drag.

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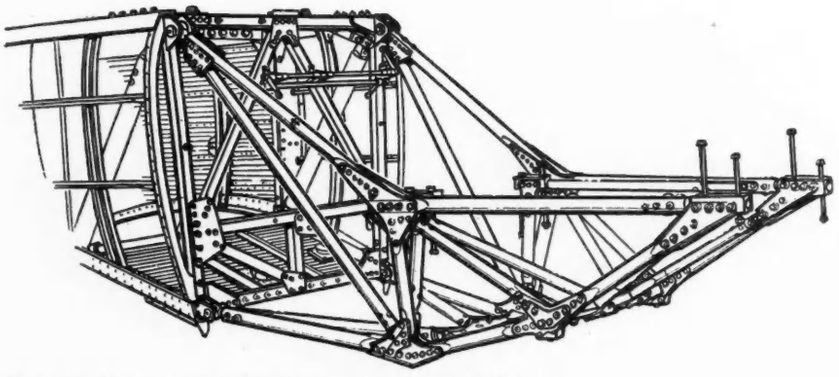

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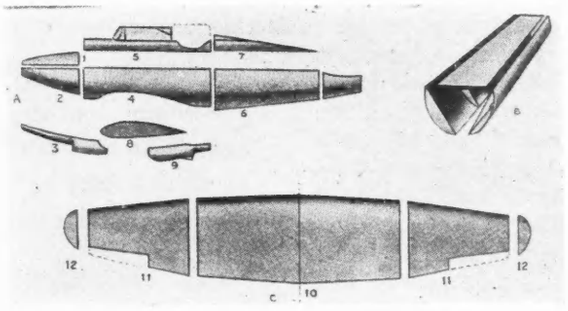

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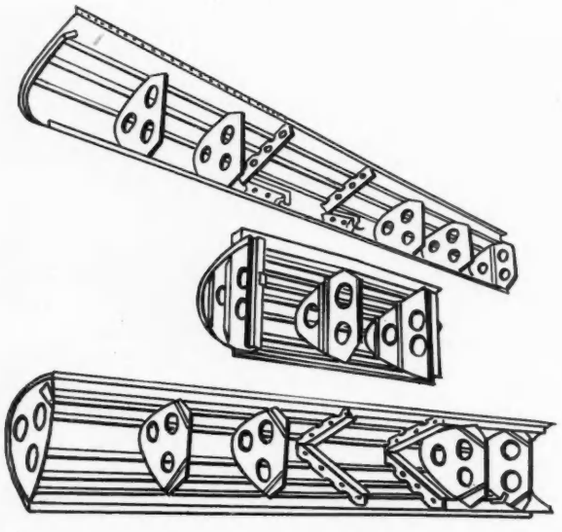

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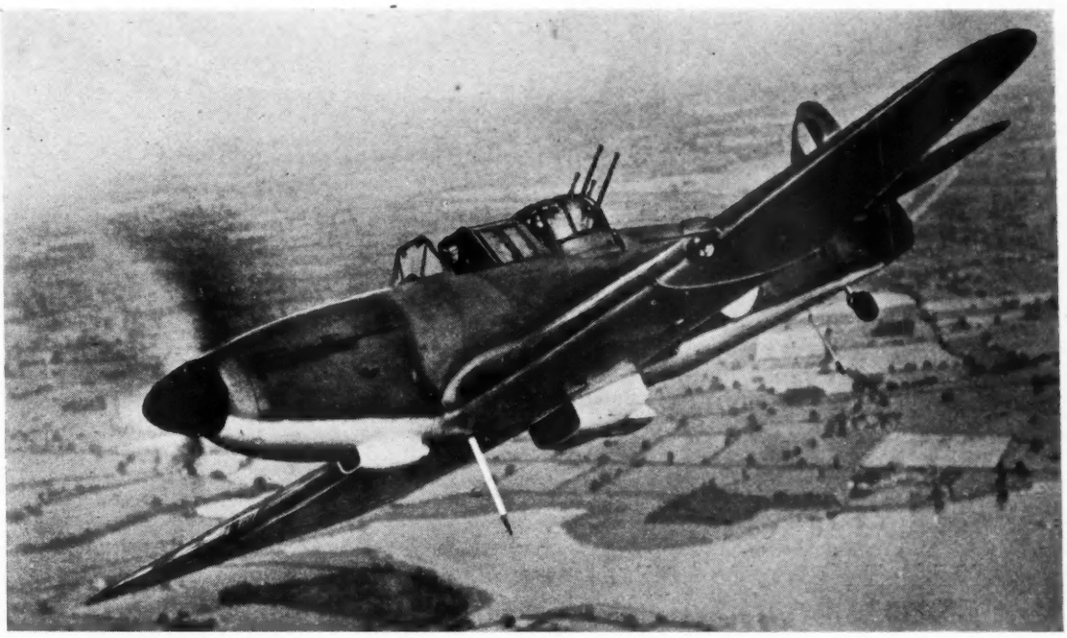

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Blackburn Roc fighter with four-gun turret like on the Defiant. Note the position of the fairings fore and aft of the turrets. On the lower plane they are shown in position for action and on the upper plane in the flight position to reduce drag.

A Junkers Ju 88 dive bomber that made its last flight over England. Note the diving brake under the starboard wing. Bombs are carried in external racks under the wings on both sides of the fuselage.

GERMANY is Europe's most efficient mass production nation and as the master of the use of "ersatz" materials, she is carrying on a war which is taxing even our great resources with her outside supplies cut off and much of her manpower in the military forces. In spite of this German military airplanes are well built and efficient despite an often clumsy appearance. The materials are well suited to work which they perform and the workmanship, while inferior to the finish of the best American planes, is good.

The engineering is well done and sound, although many practices now considered old fashioned here are employed in Germany. German designers have kept the consideration of field servicing of their planes by unskilled or relatively unskilled mechanics uppermost in mind and everything has been done to permit easy servicing and the field replacement of damaged parts quickly and by parts which can be easily transported.

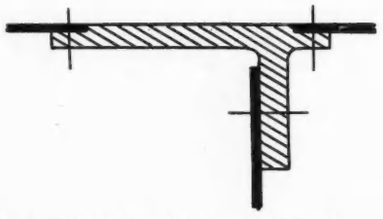


Fig. 1—The Heinkel He 111 wing spar flange.

Courtesy of AIRCRAFT ENGINEERING (England)

German military planes are all-metal save the gliders, which usually have fabric covered tubular framework for the fuselage construction and plywood wings. The Germans, in common with most Europeans, still use many wooden propeller blades even in the latest types of controllable hubs. This is not done so much as an aluminum conservation measure, but as a means of getting propeller blades of a desired width of chord and type of airfoil and still keep weight within bounds and close to the hubs. Most German bombers carry at least a portion of their bomb load on the outside of the fuselage, the bomb carriers being designed to fair the bombs into the wings and in many cases jettisonable fuel tanks are carried in the same manner.

While, like ourselves, the German engineers construct their wings so that the skin is stressed they carry their beam loads on heavy spars and use the skin to carry torsional and drag loads only. This permits the use of lighter wing coverings which are theoretically more desirable than the thicker skins carrying both drag and flying loads. These wing spars are built up of sheet metal wherever possible in order to facilitate production and extruded forms or sections are used only where the thickness of the metal must be too great for sheet forming.

Enough German warplanes have been brought down in England in good condition to permit them to be studied thoroughly and also, in many cases, to be test flown, so that the data upon them are authentic. Our study in this article is based on the Heinkel He111 bomber, Junkers Ju87 and Ju88 dive bombers, Messerschmitt Me109 and Me110 fighters and the Dornier Do17 two engine bomber, data for which were obtained from reports issued by the British Ministry of Aircraft Production.

A study of the different wing spar flanges is instructive and interesting. Fig. 1 shows the Heinkel wing spar flange in which the web is of sheet metal riveted to extruded flanges that are extruded or milled to form the seats for the wing cover plating riveted to the flange. The top of the flange extends to the surface of the wing, giving a maximum depth possible and making a very strong spar. The Messerschmitt flange section shown in Fig. 2 is more complicated and less efficient, but still an excellent production job. Here it will be noticed that two simple angles are riveted to a vertical sheetmetal web and a flat extruded stiffener placed upon the angles to form a stiff T-section to which the skin is riveted.

The Dornier design (Fig. 3) is complicated, but interesting. This spar flange is made up of two extruded channels connected to each other by a series of channels riveted inside of web channel to form a

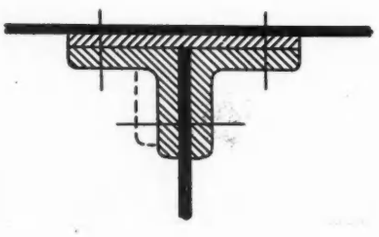


Fig. 2—Flange section of the Messerschmitt Me 109 and Me 110 wing spar.

Courtesy of AIRCRAFT ENGINEERING (England)

By Henry Lowe Brownback

An Analysis of

German Warplane Construction

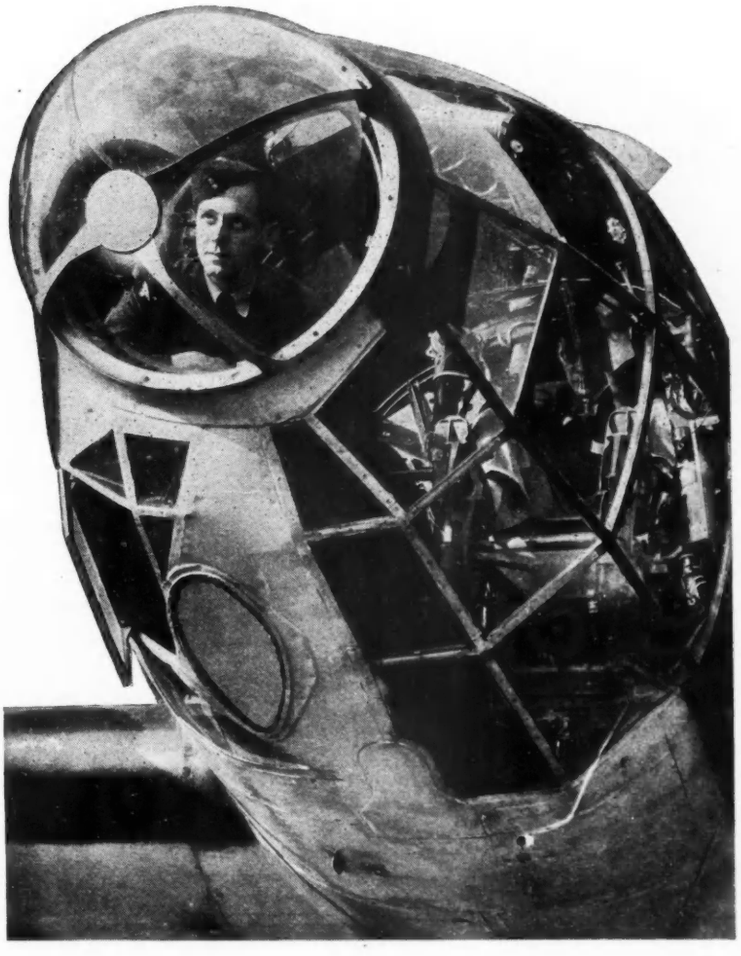
truss girder. The small sheet metal Ell-section shown is riveted to the covering to act as a locating member during construction. Possibly the most complicated of the German spar flanges is the Junkers type (Fig. 4), in which a sheet metal web is riveted to a T-section extrusion, which is reinforced by an extruded bar and the skin is fastened to stringers or ribs which pass over the spar, thus making this member far shallower for the same weight than the other constructions shown.

One interesting point of the German wings is that the wing skin is fastened to ribs running at right angles to the main spars and parallel to the line of flight rather than over a series of girders running lengthwise in the wing and connected by spacers. This construction, which is like the old cloth-covered wooden wings, keeps the wing in shape and prevents cross-wind "washboarding," thus increasing the efficiency of the airfoil. The Messerschmitt employs a number of spanwise stringers, being more like the American and British designs than the other German jobs in this respect.

We will omit most of the Messerschmitt construction as the immense amount of publicity given this machine has resulted in wide publication of its details. One most interesting feature is the method of building the fuselage (Fig. 5). This is made of a number of continuous stringers to which pressed sections of metal are fastened. Every second section is made of two halves joined at top and bottom. The ends form two frames to which plain speets are riveted to form the intermediate section.

Getting back to wings, the Junkers and the Messerschmitts have two wings fastened to the fuselage on either side while the Dornier has a continuous wing which is fastened across the top of the fuselage. The Heinkel has a three-piece wing made up of a center-section and outer wing panels.

The attachment of wing sections requires accurate fitting that involves reaming in complicated jigs when the usual construction is used, so the Germans have gone in rather strongly (Junkers, Heinkel and Dornier) for a type of attachment used in France on the Breguet biplane and later in the low-wing Junkers. This is a simple ball and socket joint as shown in Fig. 6, which eliminates much fitting. The Heinkel center section is in one-piece and the spars fit into slots in the fuselage bolting through fittings in the web to make a light, efficient attachment. Messerschmitt



This view of a Heinkel He 111 nose shows the built-up construction that is typical of German design. By using small panes of transparent plastic sheets, this method facilitates servicing since it is necessary to replace only damaged panes. British experts regard this two-engine bomber, which was used extensively in night raiding over England, as the most efficient and the easiest to produce of the six German warplanes mentioned in this article.

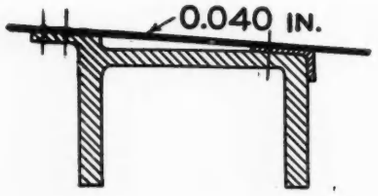
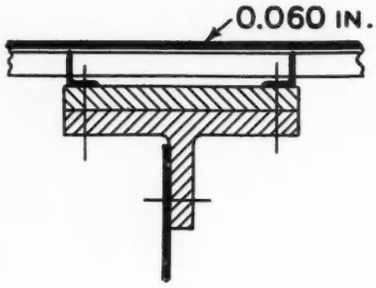


Fig. 3 — Dornier Do 17 spar flange.



Courtesy of AIRCRAFT ENGINEERING (England)

Fig. 4 — Junkers Ju 88 wing spar flange.

attaches his wings on each side of the fuselage using one large vertical bolt on the upper spar boom of the wing and one horizontal bolt on the lower spar boom.

The fuselages of the Junkers, Heinkel and Messerschmitts are constructed with no unnecessary openings from the fuselages and the wing de-icers differ from our pulsation type. They are of the exhaust-heated variety. The fuselages of the planes under consideration are all of the stressed skin, light alloy type. Inasmuch as fuselage design, as far as the central section is concerned, is governed by considerations of service, no reasonable comparisons can be made, but the rear fuselage sections are generally simple structures and comparisons can be made. The Heinkel machine, which certainly is the best design straight through, has a fuselage made up of continuous stringers having roughly the form of a wide brimmed flat bottomed bowl and Z frames. The rim of the bowl is riveted to the frames and the bottom of the bowl is attached to the skin by single rows of rivets. The construction shown in Fig. 7 involves no cutting of either frames or stringers. Rivets are spaced according to loads carried.

The more heavily loaded Junkers has stringers formed from strip and four T-section extruded longerons (Fig. 8). The stringers are continuous and are spaced about 3½ in. apart there being a total of 45 of them. As a consequence the stringers carry most of the load and the skin has little to do so is very thin. The Messerschmitt fuselage is made up of the sections already described fastened to stringers of roughly the shape of those used in the Heinkel. The Dornier fuselage is complex. It is formed of T-shaped frames with stringers riveted between the frames. Some of the stringers are extruded T-sections while others are formed sheet metal channels. The construction is shown in Fig. 9. (*See Page* 76.)

Throughout these fuselages it is evident that the designers have figured on frames which are easily determined to carry the loads, letting very light skins act as coverings and carrying a minor part of the load.

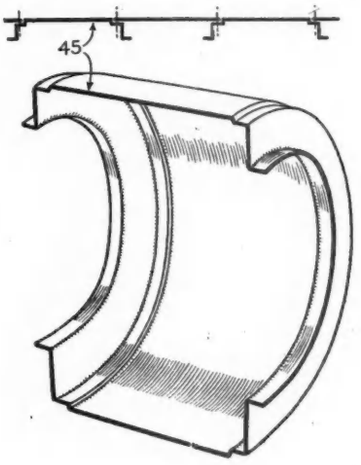


Fig. 5 — Messerschmitt one-piece plating and frames for the fuselage.

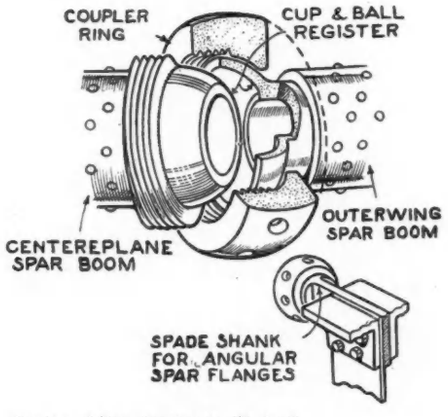
Courtesy of THE AEROPLANE (England)

One point which strikes the writer is the change from fleets of single purpose machines in Europe to those having multi-purpose, which is usually done by adding something to the one-purpose machine. The Germans have taken the Messerschmitt fighter and added bomb racks to make it a fighter-bomber and the British followed suit with their fighters. The Germans have taken the Junkers Ju88 light bomber and

The Messerschmitt Me 110 is used both as a long-range escort fighter and as a night bomber. The bomb load is carried in external racks under the fuselage.

This warplane is the Junkers Ju 87, the notorious Stuka dive bomber that created so much terror during the early stages of the war. It carries a 1100 lb. bomb under the fuselage and four small bombs under the wings. Of late it has been used mostly in the Mediterranean theater of war.

added dive bombing flaps to the wings and tail to make a bomber-dive bomber out of it. While this seems to prevent the machines from having the ideal capabilities of the real one-purpose machine, it permits machines at one point to be used for any purposes found necessary thus obviating the necessity of transporting machines and men from other parts or keeping excessive numbers of machines of different types at



Courtesy of THE AEROPLANE (England)

Fig. 6—Ball and socket wing attachment on Junkers, Heinkel and Dornier planes.

any one place. This cuts down the number of aircraft needed for various missions and just as important the smaller groups entail smaller losses in case of a heavy bombing of an airdrome.

We have heard many stories of the handling characteristics of the German airplanes and we might say here that no modern, heavily loaded fighter can be twisted around like the old World War Spads. In fact the Spanish Civil War indicated that machines having fast climb and quick handling capabilities could outfight the modern machines, but the latter are necessary to catch modern bombers, which are almost as fast as the fighters. The Messerschmitt handles nicely at speeds up to 300 m.p.h., but gets very stiff from there on and is very tiring at 400 m.p.h. and it takes a circle of 885 ft. to turn in. However, it can get out of very small fields and the wheels are carried far forward permitting stiff brak-

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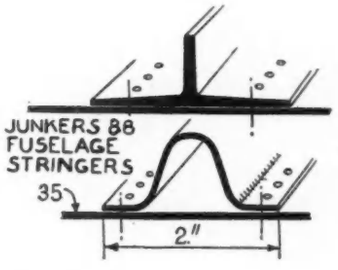
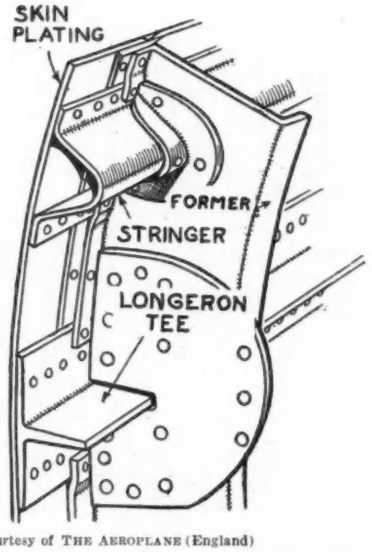




Courtesy of THE AEROPLANE (England)

Fig. 8—Junkers longerons and stringers.

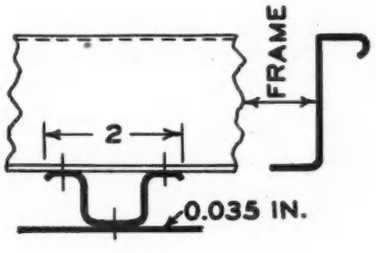


Fig. 7 — Heinkel fuselage stringer and frame.

Courtesy of AIRCRAFT ENGINEERING (England)

Airbriefs

By HENRY LOWE BROWNBACK

Wooden Airplanes

Some years ago several old time airplane experts sat together. They were of different nationalities and were discussing the possibilities of war and what would happen to airplane construction. On all sides the return of the wooden airplane was predicted as it can stand rougher handling than the all-metal type and can be quickly repaired with some plywood and glue overnight so as to get a damaged plane into the air next morning. This prediction will soon come true for every type of plane save the pursuit. The molded wood or so-called "plastic" airplane has caused lots of comment, but modern adhesives make the flat plywood airplane just as interesting.

Saint Elmo's Fire

Most of us have read of or seen the ball of fire at the masthead of a ship under certain atmospheric conditions, but most have not seen the beautiful but rather terrifying spectacle of a similar discharge from the tips of a propeller, turning it into a vast pinwheel. Sometimes running through thunderheads will produce weird effects.

Drawings

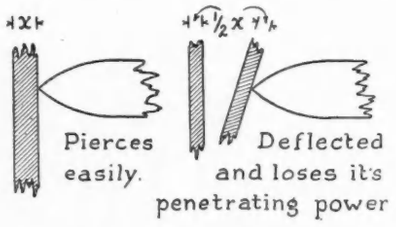
Lately I have been shown quite a few working drawings for military airplanes made for the use of sub-contractors, who are not familiar with aircraft. These drawings leave a lot to be desired as they are rather sketchy and contain few real dimensions. Drawings for wing rib and other such assemblies should be made on metal and the real frame sizes INSIDE of the skin shown to avoid the need for inexperienced men to do mold-loft work. The size of every part, no matter how small, should be listed on a separate sheet and not left to scaling a paper print.

Confusion

Production in some plants has been confused by the sending out of vast numbers of prints to subcontractors for bids marked "NOT TO BE USED FOR PRODUCTION" and then sending out other prints marked the same way used for sample production and telephoning constant changes. If changes are made, the contractor should be certain that he collects and destroys all outstanding prints. Most subcontractors are experts in their lines, but know little of entire aircraft structures and many of them have no engineering or production departments worthy of the name nor could they afford them or organize them in time to operate efficiently.

Armor Plate

We don't like the German's warlike nature, his diplomacy or his politics but, at times, we have to admire his technical work and the system of armor plating which he is using in his airplanes and his armored vehicles. A light armor-piercing shell or bullet will go through incredible thicknesses of armor plate if it hits it squarely, but



if it strikes at a slight angle most of its penetrating power is lost. Taking advantage of this the German designers use two thicknesses of armor set at an angle to each other. If the bullet strikes the first one straight, it will strike the other at an angle or vice versa, and much of the effect of modern high-speed projectiles is nullified.

Propellers and Deicing

Metal propellers have a tendency to ice under icing conditions and as any ice formation will throw them out of balance and possibly cause a severe accident, precautions must be taken. These have consisted of everything from certain coatings, to which the ice is supposed not to cling, to discharging exhaust gas through hollow blades. The grease coating may cause unbalance and American airline experience seems to show that alcohol ice prevention is the best method. Shoes are used to insure the even spreading of the alcohol over the blade.

Ice in General

We all know the effects of wing icing and how it can soon bring a plane down because of added weight and distortion of the airfoil section which can cause such severe changes in lift and center of lift that control is affected. Few realize that ice forming in the carburetor venturi is a most serious trouble breeder because of its ability to cause loss of power and chunks of ice can cut loose and fly into a fast turning supercharger impeller and cause trouble. Here again the alcohol prevention technique has been used and modern airline and military engines are fitted with carburetors designed to avoid this trouble. However, ice often forms in other parts of the induction system and great care must be used to avoid any icing between the carburetor air intake and the supercharger impeller.

Ice formation on windshields is very dangerous and various means are used to avoid it varying from alcohol sprays, motor car type warm air blasts on the inside of the glass down to double windows acting as hot air conduits.

Ersatz

The Germans have started a technical school for the training of experts on substitute materials with the usual long titles with the Germans love so well. To attend it one must be a good mechanic. He is first given shop training in the manufacture and use of ersatz materials and then the promising candidates are sent to a technical institute emerging with a title I could not begin to say let alone spell. However, the basic idea is good and might be well worth while studying. I have always been impressed with the type of technical school which combines practice and theory instead of majoring in pure theory. It has always been my thought that engineering should not be a course per se but a post graduate course to a fine basic education in which science has been stressed. Nothing is more pathetic than to see an engineer or draftsman who goes into the shop without much practical knowledge and cannot tell the shop men how to do something or make something which he has designed or to see and talk to a graduate in science who lacks the rudiments of a cultural education.

Wing Location

Lindbergh crossed the ocean in a high wing monoplane and the trade rushed to high wing monoplanes. Several Americans built remarkable versions of the German low wing metal monoplane technique and builders of everything but the "baby" planes rushed to this type. Now we see many mid and shoulder wing foreign military planes, so we may look once more for a variety of designs and not big and little all alike. This standardization took place to a limited extent in the last war when a whole series of British planes with the D-H as the largest member of the family and the SE5 as the baby had a strong resemblance.

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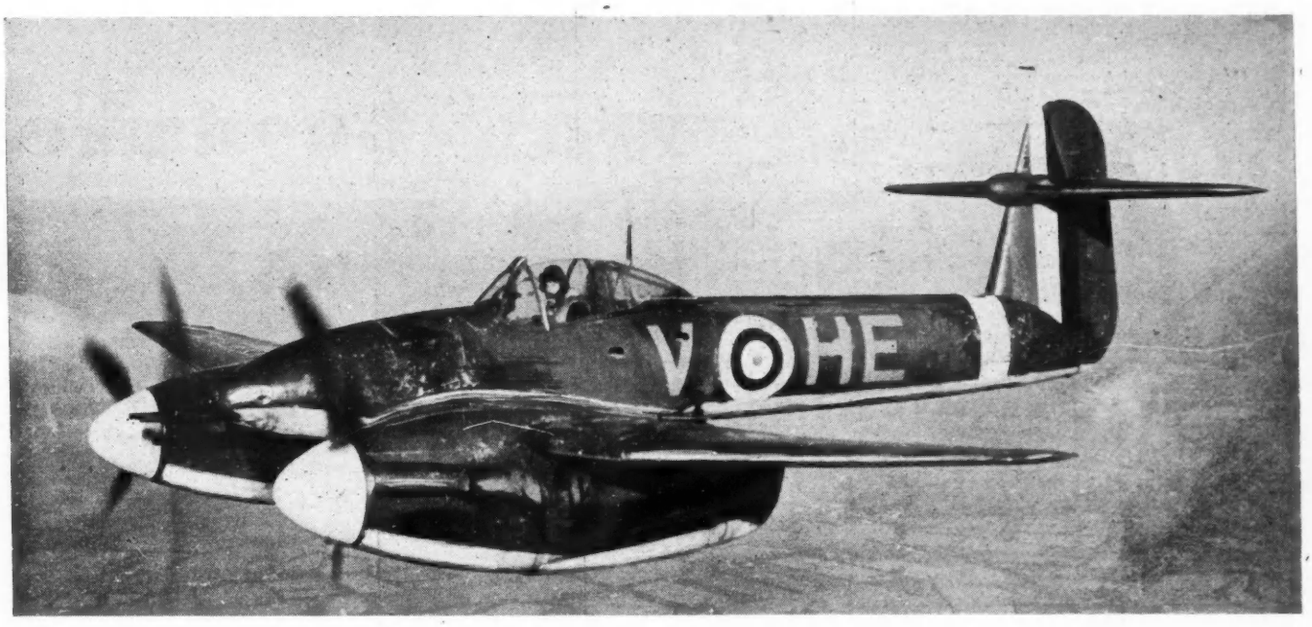
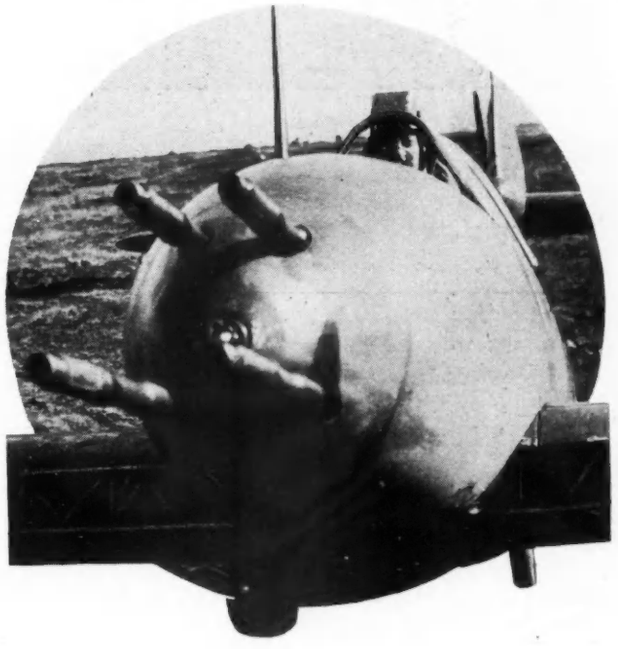
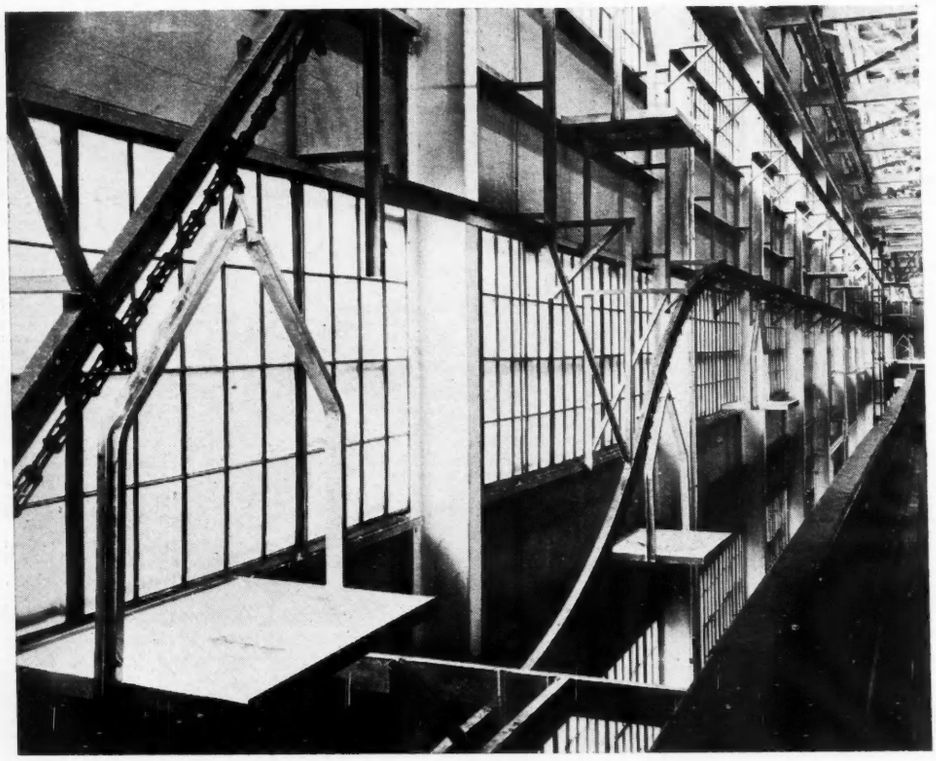


The Westland Whirlwind



THE Westland Whirlwind, now in use by the British as a bomber escort, resembles the Lockheed P-38. Driven by two 885-hp. Rolls-Royce Peregrine engines, it is said to have a top speed of approximately 350 m.p.h. at 16,000 ft. Easily recognized by its high-set tailplane (illustration below) whose juncture with the stabilizer is covered by an acorn-shaped fairing the Whirlwind has a fire power of 600 lb. per min. through the four Hispano cannon (illustration in circle) mounted in the nose. Radiators are located in the leading edge of the wings between the fuselage and the motor nacelles. This new fighter has a wing span of 45 ft. and is 32 ft. 5 in. long by 10 ft. 10 in high.

New

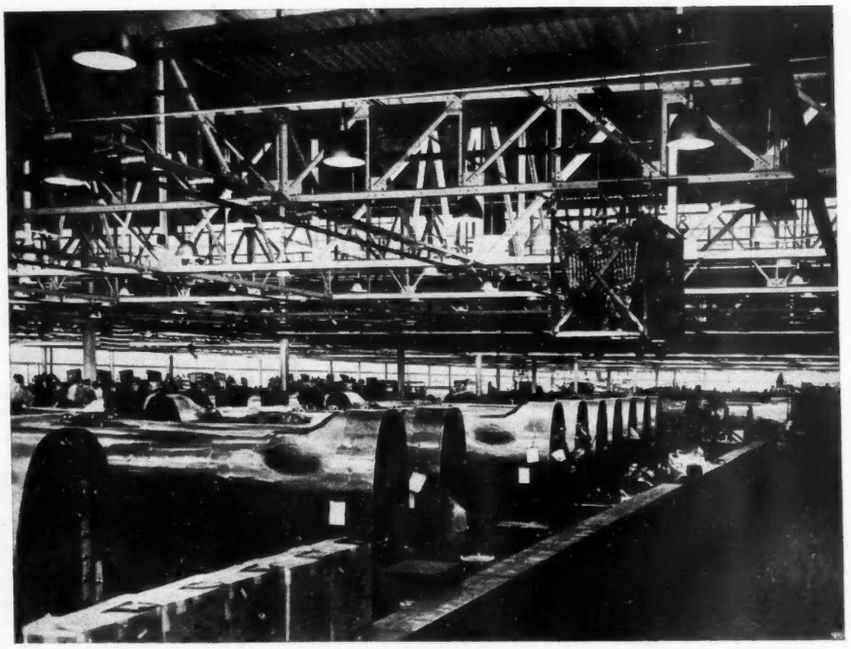


Showing how the conveyor track is supported from the steel frame of the building

IN MASS production of the huge modern bombers and flying ships, new and difficult materials handling problems arise which it has proved impossible to solve with existing surface conveyor systems. Small parts in large numbers often must be transported to and from several departments where special operations are performed on them, and the amount of transportation required has reached such a volume that existing aisle space is overcrowded and trucking facilities are overtaxed. To relieve the situation, the Glenn L. Martin Company in its bomber factories installed an overhead chain conveyor system which is expected to reduce the volume of traffic through the aisles by 30 per cent and to relieve congestion there. The system also offers other advantages and is expected to effect savings which will equal the cost of its installation in a year and a half. Material too large to be handled on the overhead conveyor can still be moved by the aisle trucking system. Stations on the conveyor system are fixed, and material transported by it always arrives at and leaves from exactly the same place, in which respect it differs advantageously from the trucking system. Since the installation of the overhead conveyor, material does not accumulate in any department but is loaded immediately upon being finished.

The conveyor system had to be adapted to existing buildings, and in one case, where the conveyor passes through the floor, a large opening had to be cut in a 13-in. concrete floor. In other cases openings had to be made in brick walls for the cradles to pass through, and a clearance of 6 in. was then provided on each side, to allow for possible swaying. The size of the carriers used was limited by the existing building structure.

I beams 20 ft. in length are used for the conveyor track, and are welded together to form a continuous circuit. The track is carried by supporting steel frames welded to structural members of the building where possible, and clamped to them where fire haz-

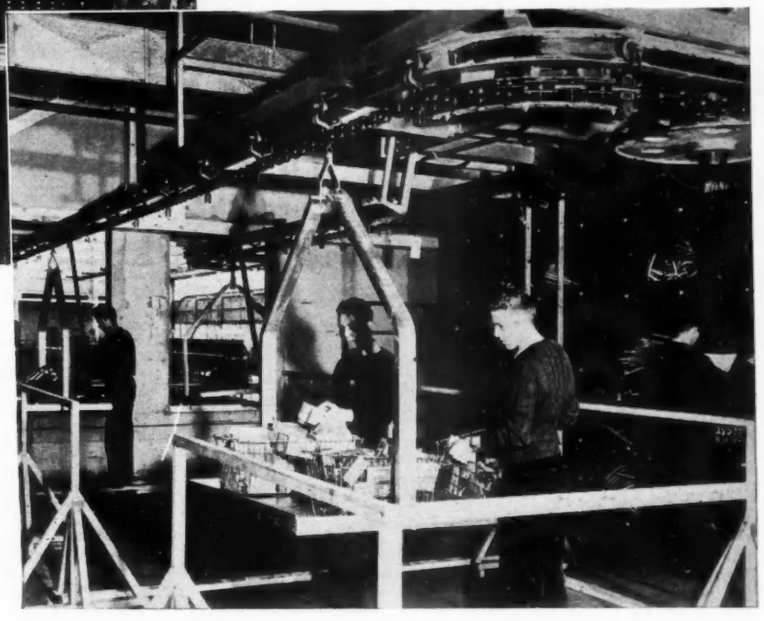


Delivering a Continuous Supply of Parts to the Final Assembly Line

Overhead Conveyor System in Martin Bomber Plant

(Left) Raw Materials and Parts for Bombers Are Loaded in the Stock Room

(Below) Unloading a Tray at the Finished Parts Stockroom



ards made welding impracticable. These supports are spaced 15 ft. apart. The track sweeps down to the loading stations, where the carriers drop to within 2½ ft. of the floor; at some points they reach a height of 50 ft., while the average elevation is 18 ft. The tray of the carrier is about 6 ft. below the track attachment. Additions to or changes in the trackage are easily made, the connections to the building structure being burned off or unclamped, new sections installed, and links added to the conveyor chain as they may be necessary.

The longest system, 3200 ft. long, starts at the raw stores, where there is a floor-level station. From there the track sweeps up and passes over the roof trusses to the finishing and plating department, and continues to three other store rooms and to the machine shop and the final assembly department, in each of which there are several stations. The system feeds to and from existing overhead systems and to a station where fabricated parts can be loaded on trucks for delivery to other buildings. There is also a shorter system, 1200 ft. long, which serves a department in which bench work and finishing operations are performed. Additional installations are already being planned.

This overhead conveyor system is designed to operate continuously at a speed of 30 ft. per min.—a speed deemed sufficiently low to permit enough time to load or unload a carrier in one station. At this speed a tray arrives at a station every 30 sec. Power is provided by a 5-hp. electric motor which is geared down in the ratio of 500 to 1, driving the conveyor chain through a V-belt drive and a worm gear. Turns in the track are standardized and are limited to 45, 90 and 180 deg.

Loading and unloading stations are 15 ft. in length and of sufficient width to afford adequate clearance on both sides of the tray. A flat guard rail is provided to permit the material to be slid from the tray, which latter is being retained by the guard rail. In the photographs a temporary wooden guard rail is shown, but this will be replaced later by a tubular or an

(*Turn to page 78, please*)

Helping

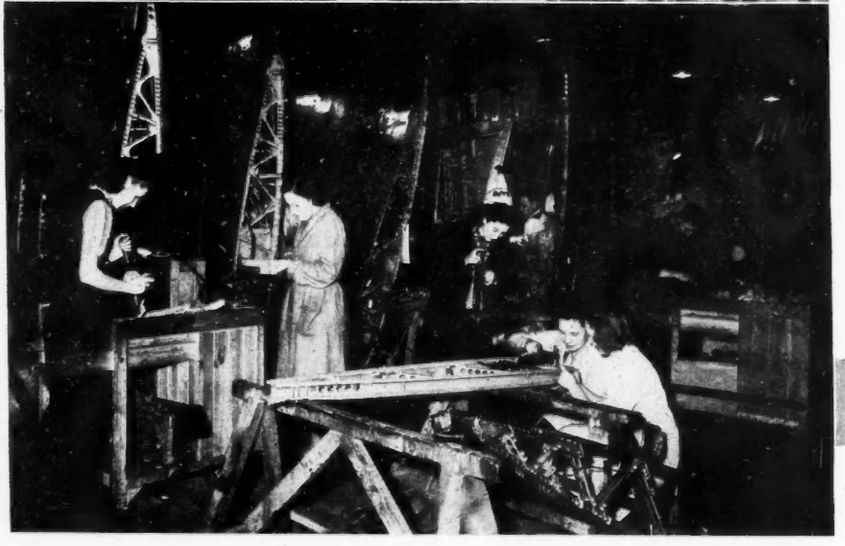
JUST as vital as flying warplanes in action against the enemy or on training flights is the job of maintaining them in proper flying trim. And it also follows that large air fleets require big ground crews, especially to sustain military operations.

To solve this problem for the R. A. F., women as well as men are being trained as flight mechanics in Britain. Many women have a natural aptitude for this type of work, which makes it possible to use them for overhauling warplanes, particularly the Hurricanes and Spitfires. These photographs show a crew of women mechanics working on a Hurricane.

Women also have an important role in the fighter "hospitals," where damaged aircraft are reconditioned for further service, or dismantled and the salvaged parts used for replacements on other machines. The British Ministry of Aircraft Production has charge of this organization. Such types as the Hurricane and Spitfire lend themselves readily to such treatment, and a high percentage of "writeoffs" are returned to service to fight again another day.

British Combine Photos

These flight mechanics are overhauling a Rolls-Royce engine.



Spitfire wings salvaged from damaged planes are repaired in this fighter "hospital" for use in the near future.

to keep R.A.F. Fighters in *Action*

Many details must be checked in servicing these warplanes. The regulation uniform, which this mechanic is wearing, was designed to facilitate the work.

Here are two flight mechanics working on a Hurricane cockpit.

This closeup gives an excellent view of the installation of Rolls-Royce engine in a Hurricane. Working on top of the engine presents no difficulty to this trained flight mechanic.

METAL-CUTTING FORCES

FORCES developed by the cutter of a machine tool and power requirements in metal-cutting operations are of importance in connection with the selection of the size of motor for the machine tool and in the design of the power transmission from the motor to the cutting tool and the feed transmission mechanism. They also serve as the basis for the determination of stresses and deflections of the frame and other parts of the machine tool and for the selection of the proper size of cutting tool, and they constitute one of the important factors governing the design of jigs, fixtures and special tools for holding the work in machining operations.

For the purpose of this discussion, the power requirements in various metal-cutting operations were obtained, such as turning, milling, drilling, planing, etc., and from these data the general conclusions may

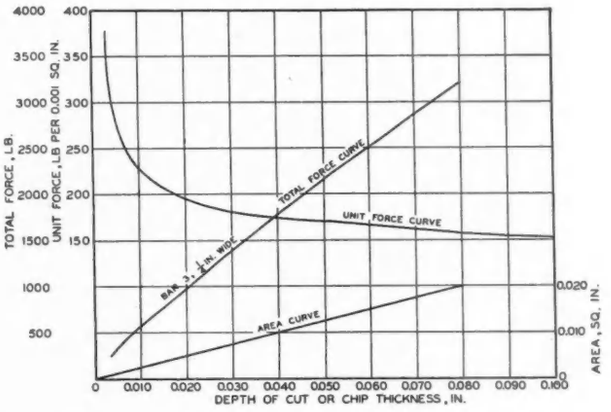


Fig. 2—Chip-thickness curves, experiment 18.
Material: 0.15 per cent carbon steel, bar No. 3.
Tool: 4-deg. clerance, 30-deg. front rake.
Chip width: ¼ in. Speed: 20 ft. per min.

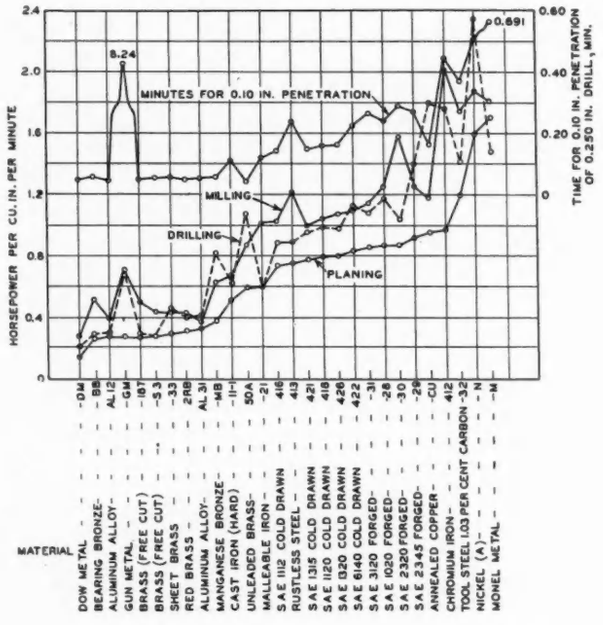


Fig. 1—Net values of horsepower per cubic inch of metal cut per minute for a variety of metals as determined for drilling, milling, and planing.
The drill used was ¾ in. dia., had a 30-deg. helix, and was operated at 153 r.p.m. and 0.012 i.p.r. feed. The planing tool was of the end-cutting type ½ in. wide, having 15-deg. back rake, no side rake, and operated at a speed of 20 f.p.m. when taking a depth of cut per stroke of 0.010 in. The milling cutter was of the end-cutting type 0.25 in. wide, 3.5 in. dia., having 15-deg. back rake, no side rake when taking a depth of cut of 0.125 in., and a feed of 0.010 in. per tooth. The penetrator drill indicating machinability was ¼ in. dia., had a helix of 24 deg., and operated under a feed load of 94 lb. at 500 r.p.m.

be drawn that the quotient of the horsepower developed at the cutter by the cubic inches of metal removed per minute—called the net horsepower per cu. in. per min.—is approximately 1.0 for steel and 0.60 for cast iron. The gross power—that is, the power developed by the motor—per cubic inch of metal cut per minute will average about 2.5 for steel and 1.2 for cast iron.

TURNING—These values will vary over a considerable range, however, depending upon the specific operation performed, the machine tool, the shape of the tool, the cutting speed, and the particular metal being machined. Fig. 1 presents values of net horsepower per cubic inch per minute for drilling, milling, and planing under specfic conditions, as outlined in the legend of the figure, for a wide range of metals. For magnesium (Dowmetal) the horsepower per cubic inch of metal planed per minute is 0.12. The value increases for a wide variety of non-ferrous metals up to about 0.6 for cast iron and malleable cast iron, and then ranges from 0.75 to 0.92 for steels; it is just below 1.0 for annealed copper, and increases to a maximum value of 1.7 for Monel metal. On the same chart similar values are given for specific conditions of drilling and milling. These values, however, are uniformly higher than those for planing, as might be expected.

If the rake of the tool or the size of cut is changed, the above values are altered. They are reduced in almost direct proportion to an increase in rake angle. They are increased if the feed or the thickness of the chip is reduced. The influence of the thickness of

and Power Requirements for Machine Tools

By Prof. O. W. Boston*

chip, as represented by the depth of cut when planing the top of a land of uniform width, is shown in Fig. 2. The area-of-cut is represented by a straight line, as it varies directly as the depth of cut. The total force at the tool point, as measured with a dynamometer, is represented by a nearly straight line drooping slightly at the lower left. The total force divided by the area of the cut gives the unit force, the values of which are a maximum for the thinnest chip and is represented by a curve. When the chip is 0.003 in. thick, the unit force is about 370,000 psi, while for 0.010 in. it is 230,000 psi. When the thickness of chip is 0.024 in., the unit force is only 190,000 psi. With a further increase in depth of cut the unit force remains practically constant. This shows that from a force or power point of view thick chips can be removed more efficiently than thin ones. The equation of the curve representing the total force F is $F = 81{,}300\ wt^{0.77}$, in which w is the width of cut and t the thickness of chip.

In nearly all metal-cutting processes the cutting force is practically independent of the cutting speed above 10 or 20 f.p.m.

HORSEPOWER AT LATHE-TOOL POINT—In a series of turning tests on a lathe, the net horsepower at the tool point was obtained by subtracting the tare power in kilowatts from the gross as recorded in a wattmeter. The gross power was obtained with a lathe under full cut. The tare was obtained with the lathe operating with all gears engaged but not cutting. Representative values are given in Table I. In the first test, a tool of high-speed steel had a shape of (8, 22, 6, 6, 6, 15, 3/64) 8-deg. back rake, 22-deg. side rake, 6-deg. side relief, 6-deg. end relief, 6-deg. end-cutting-edge angle, 16-deg. side-cutting-edge angle, and 3/64-in. nose radius. The feed f was 0.010 i.p.r., the depth of cut d 0.050 in., and the cutting speed V 150 f.p.m. The tool life T was 18.02 min.. The cubic inches of metal cut per minute—$f \times d \times 12\,V$—was 0.9; the gross power, 1.70 kw., and the tare power, 1.10 kw., which gives a net power of 0.60 kw. or 0.81 hp. at the tool point. When this is divided by the cubic inches of metal removed per minute, we get 0.90 for the net hp. per cu. in. per min., which agrees fairly well with the values for the similar steels SAE 2320 and SAE 2345 in Fig. 1. The net horsepower is equal to the

* Chairman of the Department of Metal Processing, College of Engineering, University of Michigan. This article is based on a paper presented April 7 at the Machine Tool Electrification Forum held at the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TABLE 1

TOOL LIFE AND POWER TESTS TURNING SAE 3140 STEEL NORMALIZED AND ANNEALED (220 B)

Test No.	Tools	f in.	d in.	V f.p.m.	T min.	Vol. cu. in. per min.	KW	HP gross	HP tare	HP net	Net hp cu. in. min.	Tang. Force "F" lbs.
1	H. S. S. 8,22,6,6,6,15,3/64	.010	.050	150	18.02	.9	1.70g 1.10t	2.28	1.47	.81	.9	179
2	C. T. S. 8,14,6,6,6,15,3/64	.010	.050	55	2.4	.33	1.35 1.05	1.81	1.41	.40	1.21	250
3	Carboloy 78B 0,8,7,7,8,0,1/32	.010	.050	1000		6.0	7.9 3.25	10.60	4.35	6.25	1.04	206
4	Carboloy 78B 0,8,7,7,8,0,1/32	.015	.050	300		2.25	2.85 1.2	3.82	1.61	2.21	1.03	243
5	Carboloy 78B 0,8,7,7,8,0,1/32	.030	.050	300		4.50	4.12 1.2	5.52	1.61	3.91	.87	430
6	Carboloy 78B 0,9,8,8,9,0,1/32	.060	.050	300		9.0	7.0 1.2	9.37	1.61	7.76	.86	855
7	Carboloy 78B 0,8,7,7,8,0,1/32	.010	.250	300		9.0	6.85 1.2	9.10	1.61	7.39	.82	812
8	Carboloy 78B 0,8,7,7,8,0,1/32	.015		290		13.0	9.75 1.2	13.0	1.61	11.39	.875	1300

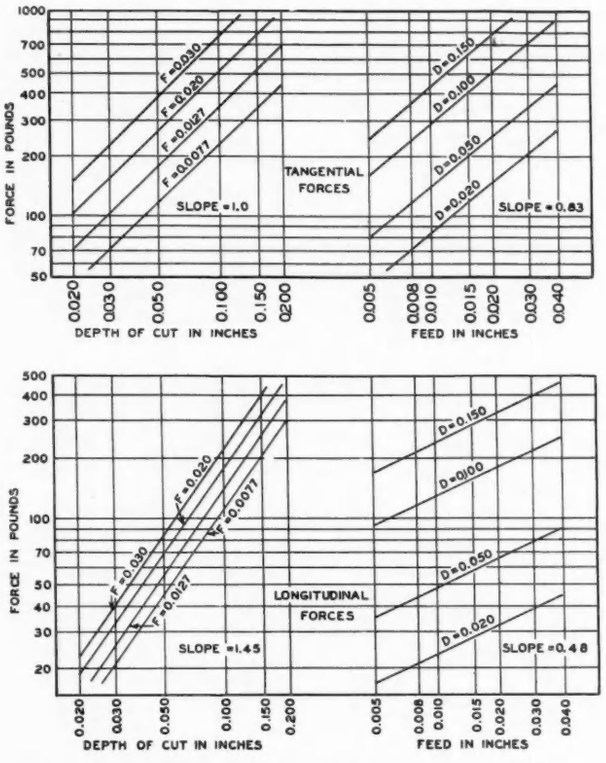


Fig. 3—Vertical and longitudinal force-test data plotted on log-log paper to determine the exponents of the cutting-force equation.

(Annealed 0.21-C steel-cutting dry-tool shape 8-14-6-6-6-0-3/64.)

product of the tangential cutting force F by the cutting speed V divided by 33,000. From this F is found to be 179 lb.

In the second cut, where a side rake angle of 14 deg. was used, instead of 22 deg., and a cutting speed of 55 instead of 150 f.p.m., the net horsepower is found to be 0.40. The net horsepower per cubic inch per minute is 1.21, and the tangential force, 250 lb. Additional tests were run with Carboloy tools, ground to a characteristic shape of 0-deg. back rake and 8-deg. side rake, operating with various values of feed and depth of cut. The net horsepower per cubic inch of metal cut per minute is shown to be 1.04 for the feed of 0.010 in. It is 0.87 cu. in. for a feed of 0.030 in. In general, the values are high for light feeds, and low for heavy feeds or for large depths.

MACHINE TOOL EFFICIENCY—The ratio between output and input power represents the efficiency of the machine tool. This total over-all efficiency is a

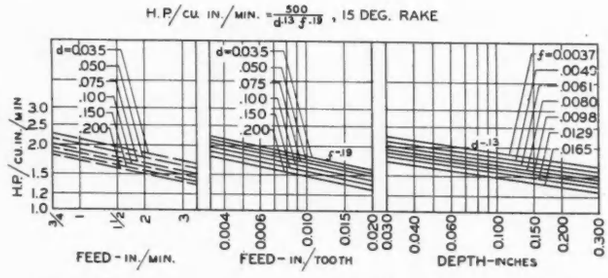


Fig. 4—Net horsepower per cubic inch per minute plotted over feed and depth.

function of both the motor and the tool. In Test 1, Table I, it is 0.81/2.28 or 35.5 per cent. The gross horsepower per cubic inch cut per minute is 0.9/0.355 = 2.54.

The efficiency of this 16-speed geared-head lathe when developing 2 hp. at the spindle was found to range from 45 per cent for the lowest speed of 18 r.p.m. down to 37 per cent for a speed of 105 r.p.m., and to 26 per cent for the highest speed of 750 r.p.m. This indicates that only about one-third of the power developed by the motor is delivered at the spindle. When 1 hp. was developed at the spindle, the average efficiency of the lathe was 25 per cent; for 3 hp. it was 50 per cent.

A dynamometer may be used on a lathe or planer in such a manner as to determine the tangential cutting force alone or the three components (tangential, longitudinal, and radial) of the cutting force. In the usual test procedure the material machined and the tool shape remain constant. Values of force are determined for a definite feed and for each of several depths of cut, as shown on the left in Fig. 3. Again, the depth may be kept constant and the forces for each of several feeds may be determined as shown on the right in Fig. 3. As shown on log-log paper in Fig. 3 all force lines for constant feeds are parallel as a rule. Therefore, in determining such force relationships, it is only necessary to vary the depth at one particular feed to get one line on log-log paper. A second line is obtained for a constant depth and variable feed, as shown on the right in Fig. 3. The slope of these lines represents the exponent of the variable, so that for the

TABLE 2

CUTTING FORCE AND FORCE EQUATIONS*

	Tool No. 1	Tool No. 2
Tool signature	8-14-6-6-6-15-3/64	8-22-6-6-6-15-3/64
Tangential force	$259000\ f^{0.98}d^{1.0}$	$174000\ f^{0.90}d^{1.0}$
	1250 lb	1110 lb
Longitudinal force	$35700\ f^{0.39}d^{1.55}$	$950\ d^{1.08}$
	480 lb	123 lb
Radial force	$7300\ f^{0.74}d^{0.28}$	$25700\ f^{0.84}d^{0.58}$
	320 lb	450 lb

* When turning an annealed S.A.E. 3135 steel dry at 50 fpm with 3/8 in. square high-speed-steel tool bits. Force values listed are for a depth of cut of 0.150 in. and a feed of 0.030 in.

tangential component of the force F_T, as shown in the upper part of Fig. 3, the exponent of d is unity. The exponent of f is 0.83. Therefore, the equation for F_T is

$$F_T = Cf^{0.83}\ d$$

By substituting the force for any given feed and depth in the formula, the value of the constant is obtained. For the conditions outlined in Fig. 3, the equations are:

$$\text{Tangential force} = 133{,}000\ f^{0.83}\ d$$
$$\text{Longitudinal force} = 33{,}700\ f^{0.48}\ d^{1.45}$$
$$\text{Radial force} = 923\ f^{0.56}$$

From these equations, values of forces can be computed for any combination of depth and feed. Cutting force equations and values of the force for a given cut in SAE 3135 steel are shown in Table 2. To obtain the power developed by the motor, the net power as determined from these forces must be divided by the

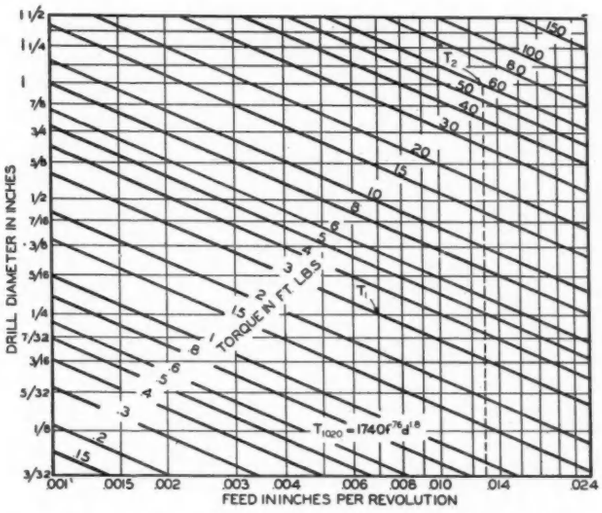


Fig. 5—Torque when drilling annealed SAE 1020 with commercial high-speed drills, Table V, using a 1 to 16 emulsion, plotted on log-log coordinates as a function of drill diameter and feed.

efficiency of the machine and motor. The net power developed by the radial component of the cutting force is zero, in as much as no speed is involved. The net power developed by the longitudinal force may be up to 5 per cent of the total power, and is determined by multiplying the longitudinal force by the feed in feet per revolution, and by the revolutions of the work per minute, and dividing by 33,000—

$$\text{Hp.} = \frac{F_L \; f \; N}{12 \times 33{,}000}$$

The net power due to the tangential force component is

$$\frac{F_T \; V}{33{,}000}$$

PROBLEM—It is required to determine the power of a motor required to take a cut of 7/8 in. feed by 1/16 in depth at 30 f.p.m. when planing heat-treated die steel, say, SAE 4350 having a Brinell hardness of 363. The force formula is

$$F_T = 48{,}800 \; f^{1.01} \; d^{1.02}$$

from which F_T is found to be 26,400 lb. The net horsepower at 30 f.p.m. cutting speed is

$$\frac{26{,}400 \times 30}{33{,}000} = 34$$

The efficiency of the planer may be assumed to be 50 per cent, which gives 68 hp. to be developed by the motor.

MILLING—Similar cutting-force data have been obtained in the process of milling. Again, the over-all efficiency of the average milling machine is low, ranging from 20 to 50 per cent. Fig. 4 shows the net horsepower per cubic inch of metal cut per minute, plotted over the feed and depth for a 3-in. diameter milling cutter having 12 teeth, a 15-deg. rake angle, a 25-deg. left-hand helix, and operating at 17 r.p.m. when milling an annealed SAE 3150 steel, with sulphurized mineral-lard oil as the cutting fluid. These curves—straight lines on log-log paper—again show that the lowest value of horsepower per cubic inch of metal cut per minute is obtained for the largest feed and the largest depth of cut. It is 1.22 for the largest depth of 0.300 in. and a feed of 0.0165 in.; 2.3, or twice as much, for the least depth of 0.030 in. and a feed of 0.0037 in. By multiplying the values from these curves, or as computed the equation shown, by the cubic inches of metal cut per minute, the total net horsepower developed at the spindle is obtained. This value should be divided by the efficiency of the machine to obtain the horsepower of the motor.

DRILLING—The torque, thrust, gross and net power input when drilling an annealed chrome-vanadium steel, SAE 6150, Brinell 187, and a soft cast iron, Brinell 163, are shown in Table 3.

To make is possible to determine the torque T, the

TABLE 3

TORQUE, THRUST, AND POWER IN DRILLING AN ANNEALED CHROME-VANADIUM STEEL, SAE 6150, AND A SOFT CAST IRON, USING AN EMULSION OF 1 PART SOLUBLE OIL TO 16 PARTS WATER*

Drill Diameter, In. d	Actual R.P.M. N	Feed, In. per Rev. f	Torque, Lb.-Ft. T		Torque Horse-power, Hp T	Thrust, Lb. B		Thrust Horse-power, Hp B	Total Output, Hp.	Input, Kw. from Wattmeter			Net Input, Hp.	Effi-ciency Per Cent
			Test	Formula		Test	Formula			Gross	Tare	Net		
Test Results on Steel, SAE 6150 Steel														
1/2	444.5	0.009	14.0	13.43	1.185	725	678	0.00732	1.193	1.6	0.67	0.93	1.244	96
5/8	368.0	0.011	22.3	23.4	1.562	838	990	0.00856	1.571	2.025	0.67	1.355	1.815	87
3/4	299.7	0.012	34.3	34.8	1.957	1,269	1,273	0.01153	1.975	2.42	0.67	1.75	2.34	84
1	228.1	0.013	62.4	62.4	2.71	1,862	1,820	0.01394	2.724	3.176	0.57	2.606	3.49	78
1 1/4	175.1	0.015	110.8	104.0	3.694	2,430	2,520	0.01611	3.710	3.87	0.57	3.3	4.42	84
1 1/2	149.0	0.015	143.3	144.0	4.07	3,000	3,020	0.01693	4.087	4.507	0.507	4.0	5.35	76
Test Results on Cast Iron														
1/2	446.0	0.009	6.3	5.6	0.535	530	436	0.00614	0.541	1.12	0.67	0.45	0.602	90
5/8	364.4	0.011	10.2	9.9	0.708	645	615	0.00652	0.715	1.32	0.67	0.65	0.870	82
3/4	299.7	0.012	15.7	15.05	0.896	803	778	0.00728	0.903	1.48	0.67	0.81	1.084	83
1	229.8	0.013	27.9	28.1	1.221	1,088	1,088	0.00822	1.23	1.72	0.50	1.22	1.635	75
1 1/4	179.4	0.015	46.4	47.8	1.585	1,403	1,481	0.00954	1.60	2.025	0.45	1.575	2.110	76
1 1/2	153.4	0.015	65.9	68.7	1.925	1,700	1,778	0.00988	1.94	2.27	0.37	1.90	2.550	76

* Standard twist drills were used with 31-deg. helix angle, 121-deg. point angle, 136-deg. chisel-edge angle, and 5-deg. relief angle. The ratio of web thickness to diameter was 0.14 for the 3/4 in. and larger drills, 0.162 for the 1/2-in.-dia. drills, and 0.185 for drills up to 3/8 in. dia. Speed 60 f.p.m.

thrust B, or the power for any other combination of diameter and feed, the following equations were derived from results of experiments in which the drill diameter d and feed f were varied separately.

For the steel,

$$T = Cf^{0.78}d^{1.8} \text{ or } T_{6150} = 1{,}840f^{0.78}d^{1.8}$$

$$B = Kf^{0.78}d \text{ or } B_{6150} = 53{,}400f^{0.78}d$$

For the cast iron,

$$T_{CI} = C_{CI}f^{0.6}d^2 \text{ or } T_{CI} = 380f^{0.6}d^2$$

$$B_{CI} = K_{CI}f^{0.6}d \text{ or } B_{CI} = 14{,}720f^{0.6}d$$

Values of torque for any drill diameter and feed may be obtained from the log-log graph, Fig. 5. The torque for a ¼-in. drill operating at 0.007 in. feed in the SAE 1020 steel is 3 lb-ft. at T_1, the intersection of the horizontal line through the ¼-in. drill size and the vertical line through the 0.007 in. feed. T_2 represents 60 lb-ft., the torque developed by a 1-in. drill operating at 0.013 in. feed. The torque for other steels may be obtained by multiplying the value from Fig. 5 by 0.90 for SAE 1035, 1.06 for annealed tool steel, 1.15 for annealed SAE 3150, and 0.69 for SAE 1112 steel.

The total net horsepower developed at the drill point is equal to the sum of the horsepower due to torque and that due to thrust—

$$\text{Hp.} = \frac{2\pi Tn}{33{,}000} + \frac{Bfn}{12 \times 33{,}000}$$

To illustrate, the 1¼-in. diameter drill with a feed of 0.015 in., rotating at 175.1 r.p.m. (60 f.p.m.) when cutting SAE 6150 steel (Table 3) is under a torque of 110.8 lb-ft. and a thrust of 2430 lb. Substituting these values in the above equation.

$$\text{Hp.} = \frac{2\pi \times 110.8 \times 175.1}{33{,}000} + \frac{2430 \times 0.015 \times 175.1}{12 \times 33{,}000} =$$

$$3.694 + 0.016 = 3.71$$

It is seen that the horsepower due to the thrust is only 0.016, or 0.44 per cent of the total power developed, so for power purposes the horsepower output due to the thrust may be neglected. It is of importance in design, however. Table 3 shows that the efficiency of the machine, as determined by dividing the input by the output, is highest when using small drills operating at high speed with resultng low values of torque and thrust. Similarly, the efficiency is lowest when the torque and thrust are high, even though the speed of the machine is low. It has been found that torque and thrust are only slightly affected by a change in cutting speed. The power, however, is a direct function of the speed.

The horsepower per cubic inch of metal cut per minute is obtained by dividing the total power by the cubic inches V of metal cut per minute. These formulas for steel and cast iron become

$$\frac{\text{Hp.}}{V_{6150}} = \frac{0.446}{d^{0.2}f^{0.22}} \quad \text{and} \quad \frac{\text{Hp.}}{V_{CI}} = \frac{0.092}{f^{0.4}}$$

The net horsepower per cubic inch of metal cut per minute is lower the larger the feed and the drill diameter. In drilling SAE 6150 steel with a ½-in. drill at 0.009 in. feed, a value of 1.443 is obtained. In drilling the same steel with a 1¼-in. diameter drill at 0.015-in. feed, the horsepower per cubic inch per minute is 1.075. For cast iron, these values are 0.605 and 0.493, respectively.

Engineering Problems Associated with Air Cargo Transportation

BASICALLY the performance and general external appearance of a cargo airplane should not differ from any similar-sized passenger transport as the primary requirements for both are defined by speed, payload and trip lengths. That is a conclusion reached by R. D. Kelly and W. W. Davies, of United Airlines Transport Corp., in a comprehensive study of the engineering problems relating to cargo transportation by air, which is contained in a report to the Society of Automotive Engineers. Items recommended as definitely needed include supercharging equipment, complete propeller and wing de-icing equipment, adequate heating and ventilating equipment, 24-volt electrical system, full cabin lighting system, cargo storage and tie-down equipment, nose wheel, flight engineers' station and equipment on all planes with more than two engines, and radio, including instrument landing units.

In order that no over-optimistic assumptions would be made with respect to payload, a thorough weight analysis was performed for the individual airplanes, the results of which are shown in the payload curves for 200 and 500-mile trip lengths (Figs. 1 and 2). The analysis was made for airplanes of from 20,000 to 60,000 lb gross weight, which appears to be the likely maximum range of cargo airplanes, based on present trends and studies. The curves show that the payload increases more rapidly for gross weight increases at the lower weights than at the higher values, though the slope becomes more nearly constant above 40,000 lb.

The direct operating cost curves (Figs. 3 and 4) indicate the already understood relation that increase in power loading gives increased cost, particularly when the payload percentage is decreased by the increased weight of the engines and additional fuel required to operate. It is interesting to note that the cost for the various gross weights at the lower power loadings cling closer together than for the higher loadings, due to several factors but primarily because of the lesser slope of the payload curve for the lower

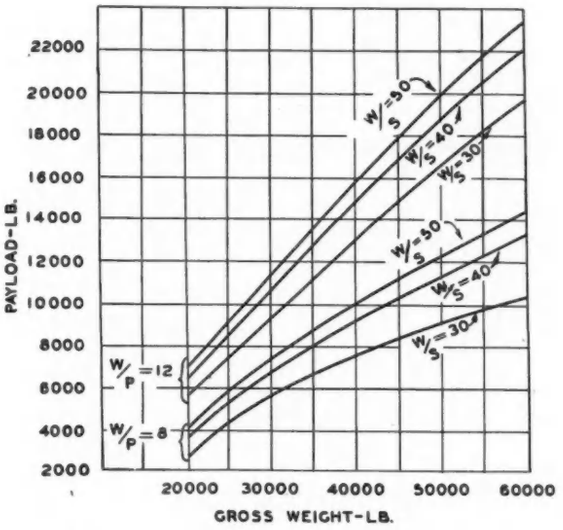


Fig. 1—Payload trend for 200-mile range.

power loadings. It should also be noted that there is relatively little change in operating costs between the airplanes of various weights for the trip lengths investigated.

The study was expanded to include the wing loadings of 30, 40 and 50 lb. per sq. ft., and power loadings of 8 and 12 lb per hp. Power loadings were based on METO power conditions. When the METO power per engine exceeded 2000 hp, one more engine

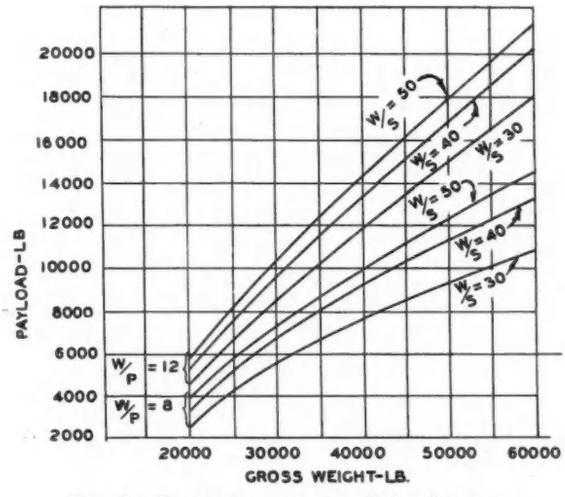


Fig. 2—Payload trend for 500-mile range.

was used. This gave several three-engined airplanes.

Generally speaking, the centralization of roomy, accessible compartments near the center of gravity as practicable is recommended for cargo location. The center section portion of the wing of large airplanes can probably be used to advantage for major cargo storage since it can connect directly with the fuselage space. The authors do not advocate the use of the nose of the fuselage or the aft section for cargo storage unless they communicate directly with the main cargo space, and are used for special purposes, for example, lightweight cargo such as flowers traveling long distances, requiring a minimum of handling.

The need for good temperature control, ventilation, lighting, and supercharging must not be overlooked by the designer as these items must be taken into account in the transport of cargo by air. The need for temperature control is already recognized because flowers, certain food stuffs, birds, etc.,

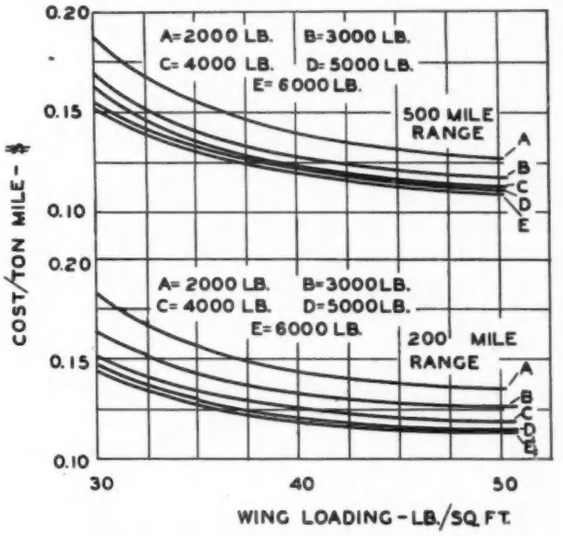


Fig. 3—Direct operating cost for power loading of 8 lb./hp. and 100 per cent load factor.

must be protected against freezing. Other items need to be kept cool for preservation. This calls for adequate heating and possibly cooling equipment, the control of which must be automatic.

Safety considerations for the cargo airplane must be equal to that provided for passenger transportation. Of these safety considerations, fire prevention, detection and control stand out as presenting the most serious problems. The cargo plane designer also is faced with the necessity of developing an airplane which will not be critical to moderate variations of the center of gravity.

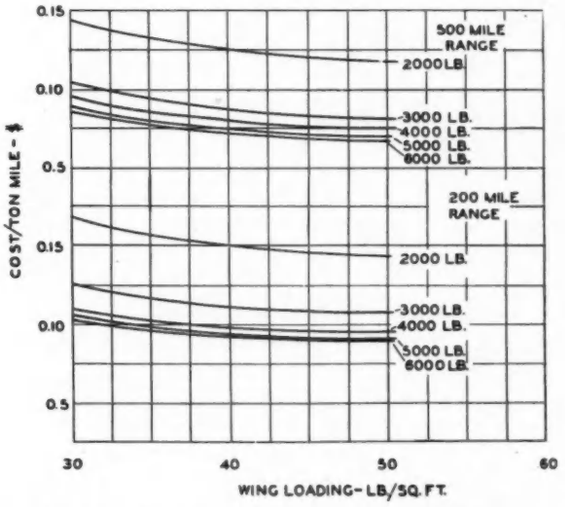


Fig. 4—Direct operating cost for power loading of 10 lb./hp. and 100 per cent load factor.

Automotive Industry Intensifies Its

THE MASS production system of the automobile industry has long been based on the principle that parts and materials be purchased to the greatest extent possible from the most efficient and economical suppliers. As examples of the wide scope of this practice under normal conditions it may be pointed out that one passenger car manufacturer bought more than 2200 productive items from a list of 1200 outside industries; another company had 8000 firms from which it bought supplies at various times. One of the first industries to convert completely from peace to war-time output and with more than $13 billions in orders on their books, the automobile manufacturers are now depending more than they ever have before upon suppliers to meet their production quotas. All-out armament production by U. S. industry requires that more and more manufacturing plants be brought into the effort if the huge totals of planes, tanks and guns upon which President Roosevelt has set the nation's sights are to be met in 1942.

The purchasing departments of the automobile companies are highly efficient organizations. They must see that parts are bought cheaply to keep mass production costs down, that quality standards are met and that the flow of material is maintained on schedule so that production is not interrupted. This long experience has proved invaluable on war contracts, where many new sources of supply must be located in a short time. That is why the automotive industry finds subcontracting a relatively easy problem. It has been a regular part of the business for many years. In years past, some of the automobile factories were merely assembly plants for parts and accessories made elsewhere.

Subcontracts for Speedup

In his plans for speeding up the war effort, Donald M. Nelson, chief of the War Production Board, has called upon prime contractors to enlist the services of small producers through subcontracting and he has urged the letting of prime contracts to groups of small manufacturers who have pooled their facilities. There isn't a single big producer who couldn't do more than he is now doing by subcontracting part of the job, according to Nelson. There are 184,000 manufacturing plants in the U. S., of which 130,000, or 70 per cent, employ less than 25 persons each. Before Pearl Harbor some of the large automotive manufacturers were reluctant to increase subcontracting to the smaller plants because some of their own employes were idle due to curtailed automobile production. They preferred to keep their own men and facilities busy. But the huge contracts awarded since Dec. 7 have changed all that so that subcontracting is not only desirable but essential.

AC Spark Plug Division of General Motors was one of the earliest automotive plants to enlist in the war effort. The first of an order for armament was produced in March, 1941. At that time, automobile production was near capacity so normal automotive sources of supply could not readily be called upon to furnish the necessary parts. Three AC engineers began inspecting the facilities of various companies with a view to subcontracting some of the parts. Finally, 43 companies were located as supply sources for 67 of the 330 parts. These companies agreed to make forgings, cotter keys, springs, nuts, buffer disks, as well as more complicated and machined items. Only 20 per cent of the subcontractors had been automotive suppliers for AC, these being chiefly spring makers.

Of the 43 subcontractors, all but two employ less than 300 men. They include manufacturers of toys, refrigerators, fiber plastic products, files and leather goods, as well as a tool shop. In location they range from Boston and Wilmington, Del., to Cleveland, Milwaukee and Moline, Ill. However, most of them are in Michigan, at Pontiac, Holly, Flint, Detroit and Saginaw.

Follow-up Maintains Flow

Two or three AC follow-up men keep the flow of parts moving from the subcontractors. Less trouble on rejected parts is experienced with the older suppliers, such as the spring makers, than with the newer companies. Six employes at AC pass on the incoming parts in the receiving inspection department, both as to appearance and dimensions. On a total man-hour basis, 20 to 30 per cent of the complete weapon is subcontracted, but on the basis of total parts, it exceeds 20 per cent. The most difficult parts and operations are undertaken by AC, which has the necessary equipment and experience. As an example, one part requires 125 machining operations.

Oldsmobile Division of GM is doing an outstanding subcontracting job on three types of weapons for the Army. Oldsmobile is making only the three most intricate parts of each weapon. Thus of 471 parts in the three products, 462 are "farmed out" to other firms. On the smallest type weapon, 127 out of 130 parts are subcontracted.

Oldsmobile is employing 151 subcontractors on machining and supplying parts. These 151 companies are located in 53 cities in 11 States and range in location from New York City to North Carolina to Illinois. Only 56 subcontractors, or 37 per cent, were automotive suppliers of Oldsmobile before the war emergency. Sixty of the companies, or 40 per cent, employ less than 100 persons each.

The 151 subcontractors are using 2151 machines on the three jobs for Oldsmobile. Their peace-time activ-

SUBCONTRACTING

In War Production Program

ities covered a wide range of industries, including manufacturers of sanding machines, stokers, machine vises, bench machinery, tools and dies, refrigerators, sewing machines, bread wrapping machines, automatic typewriters, railroad air brakes, automatic railway devices, humidity regulators and linotype saws.

More than 460 companies were contacted by Oldsmobile representatives before the 151 subcontractors were located to do the job. Oldsmobile employs 15 follow-up men who are constantly on the road making personal contacts with the sub-contractors. Five of the 15 men are engineers who serve as technical advisers in case engineering problems arise. The other 10 have had practical technical experience and are familiar with blueprint reading, machine operations and inspection requirements. All the follow-up men were formerly automotive service representatives or inspection and engineering department employes whose jobs were washed out by the conversion to war production.

Oldsmobile has six other road men who maintain contact with manufacturers of cutting tools and gages to expedite delivery to Oldsmobile and to the subcontractors. Most of these men have had toolmaking experience. An additional four men keep in constant touch with machine tool manufacturers to see that machines are delivered on time so production schedules will not lag.

Meeting Quality Standards

General experience of Oldsmobile on the quality standards and meeting of delivery dates by subcontractors has been on the whole satisfactory. Constantly expanding production has been met without a work stoppage. Quality of the work required is necessarily high and inspection difficulties can be considered as normal. Subcontractors have met and rectified all complaints on this score.

The Pontiac Motor Division of GM also is doing a fine subcontracting job on an anti-aircraft gun. One hundred and seventy-five of the gun's 195 parts are being made by 41 subcontractors. Only 20 of the most vital parts are manufactured by Pontiac. Only eight of the 41 gun subcontractors had previously done business with Pontiac in the automotive field. All the subcontractors were located within 30 days through a personal canvass of likely suppliers as well as through the cooperation of the U. S. Navy Bureau of Ordnance and the Government's Division of Contract Distribution.

Among the suppliers located by Pontiac were companies in such diverse fields as the manufacture of cash registers, steam shovels, farm equipment, safes, saws, surgical knives, springs, sewing machine parts, outboard motors, seat covers, centrifugal pumps, timing chains, car governors and pressing machines. They ranged in location from New England to Milwaukee. Sixty per cent of the subcontractors have less than 300 employes, while only two of the 41 companies have more than 5000 workers.

Pontiac delegated two men to go on the road to solicit business and inspect the facilities of the prospective subcontractors. Ten follow-up men are now engaged in keeping the parts and materials flowing to the suppliers and thence back to the Pontiac plant.

Packard Motor Car Co. has 140 subcontractors furnishing 1420 parts for an aircraft engine it is making for the U. S. and Great Britain. Sixty of the subcontractors, which supply 529 of the parts, are situated in Michigan. The others are in Illinois, Pennsylvania, Maryland, Ohio, Indiana, New York. New Jersey, Wisconsin, Nebraska and Connecticut. One Packard subcontractor, Stewart-Warner Corp., has 64 subcontractors of its own, roughing out aircraft engine parts on which it performs the finishing operations.

Marmon-Herrington, Inc., a large producer of combat vehicles at an annual rate of $50 millions, subcontracts 73 per cent of its business. Through an extensive subcontracting department, 1400 shops, mostly in Indiana, supply Marmon-Herrington with parts and supplies. Ninety-five per cent of these shops do not possess credit standing sufficient to guarantee Government funds, so financial arrangements are made through the prime contractor. Marmon-Herrington also provides the material, blue prints and inspection.

Allison Division of General Motors relies on manufacturing plants in 34 cities to supply it with the chief fabricated and semi-finished parts for aircraft engines. Screw machine parts are produced in New Britain, Conn., valve seats and bushings come from New Castle, Pa., forgings are made in Cudahy, Wis., magnetic plugs are shipped from Clarinda, Iowa, bronze units from East Alton, Ill., bearings from Stamford, Conn., and distributors from Warren, Ohio.

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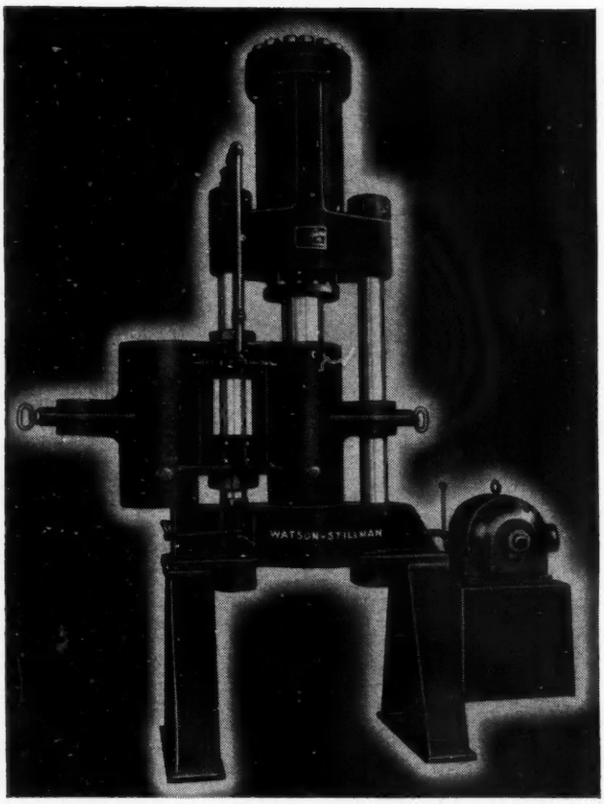
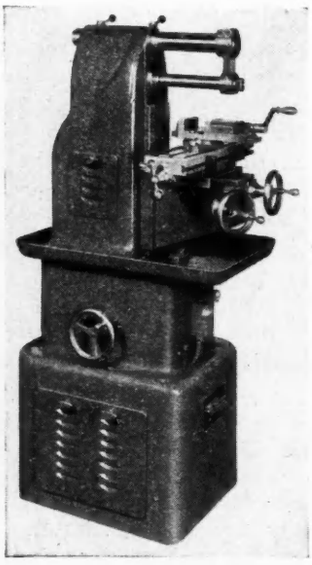
MEN and



Equipped with two containers for faster production, this Watson-Stillman hydraulic straining press operates under a pressure of 2000 psi.

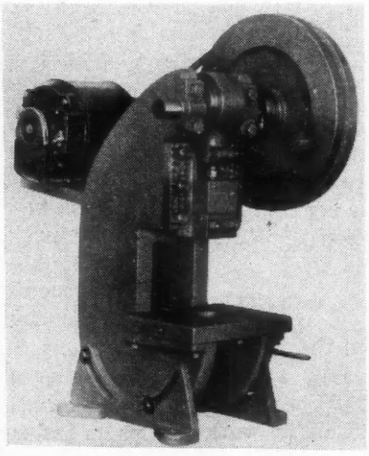
A 200-TON-CAPACITY hydraulic straining press manufactured by The Watson-Stillman Co., Roselle, N. J., is equipped with two 10- by 33-in. cylinders mounted on a swinging arm so that one container can be loaded while the press strains material from the other. The press is completely self-contained and is operated by a 20-hp. motor driving an 18-gpm. pump. The main ram has a 33-in stroke and operates under a pressure of 2000 psi.

NEW models of the Vernon No. 0 horizontal milling machine, built by the Machinery Manufacturing Co., Los Angeles, Cal., incorporate many new features. Double rows of bearings on cross and longitudinal lead screws replace single rows, and labyrinth seals take the place of oil seals formerly used. Many other improvements are said to contribute to the durability of the machine.



Vernon No. 0 Horizontal Milling Machine.

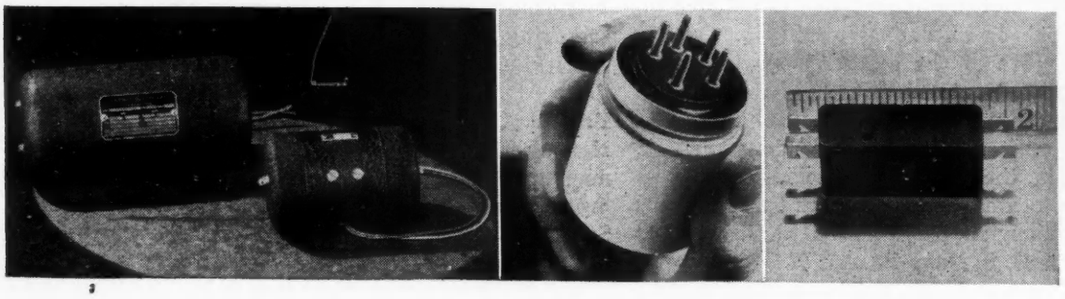
EQUIPPED with bronze bearings at all wear points, a new line of punch presses is now being offered by the Duro Mfg. Co., Los Angeles, Cal. Available in 1- and 4-ton models, these new presses have, according to the manufacturer, many new features. Punch force is transmitted by an eccentric press fitted onto the driving shaft and held securely by keys. The ram or punch of the Duro presses rides in semi-steel guides slotted for lubricant distribution and adjustable for wear. The 1-ton model accommodates dies up to 3¾ in.; the 4-ton model takes up to 4¾ in.



New Duro punch press.

SEVERAL new electrical devices for aircraft installation have been announced by the General Electric Co., Schenectady, N. Y.

One, a sensitive direct-current relay weighing only 3¼ oz., is protected by



The General Electric Switchette (right) weighing only 9 grams is particularly suitable for aircraft applications. The G.E. sensitive d-c relay for aircraft radio (center) equipment application has a single-pole double-throw contact arrangement. Direct-current dynamotors (left) are supplied in various ratings.

MACHINES

a sealed aluminum cover and is designed to meet all Air Corps requirements. It has a maximum continuous current rating of 2 amp. at 32v., and a maximum make or break rating of 10 amp. The coil is rated at 32 milliwatts minimum and 1 watt maximum. The contacts provide single-pole, double-throw operation.

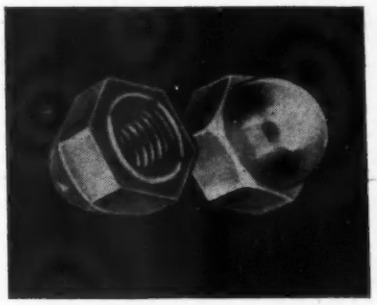
Another development—believed to be smallest switch of its type in the world—weighs only 9 grams. It can be operated by a lever, a bellows, or other actuating means by movement of the spring return button in the housing. The contacts are arranged for single-pole normally-open, single-pole normally-closed, or single-pole double-throw operation.

New dynamotors comprising five types ranging from 25 to 600 watts in output have also been announced recently. The end caps are formed aluminum or steel covers which fasten to the end shields to keep out dust and dirt. Cartridge-type brush mechanisms are used, and brush holders are anchored in the castings. Capacitors are supplied across the brushes when needed for suppression of radio interference.

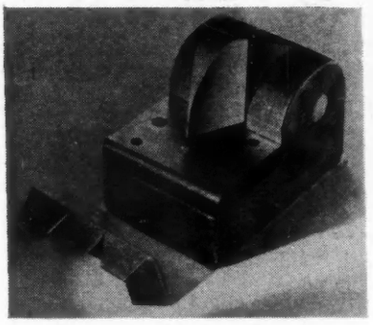
PURPORTEDLY the only pump on the market capable of pumping certain viscous materials direct from the drum without the use of heat, the Lincoln "Pile Driver," built by the Lincoln Engineering Co., St. Louis, Mo., is available in single- or two-stage models. Each model is designed in two sizes, one for use on 10-gallon drums, and the other for use on 55-gallon drums. The delivery of material in both models is controlled by a hand-operated shut-off valve at the outlet.

ONE of the most interesting of recent developments in the metal stamping field is the introduction of the 150-ton metal stretching and forming press by The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio. This is a large, versatile machine suitable for the forming of large panels for aircraft structures and equally useful for the forming of small-run panels for automotive equipment.

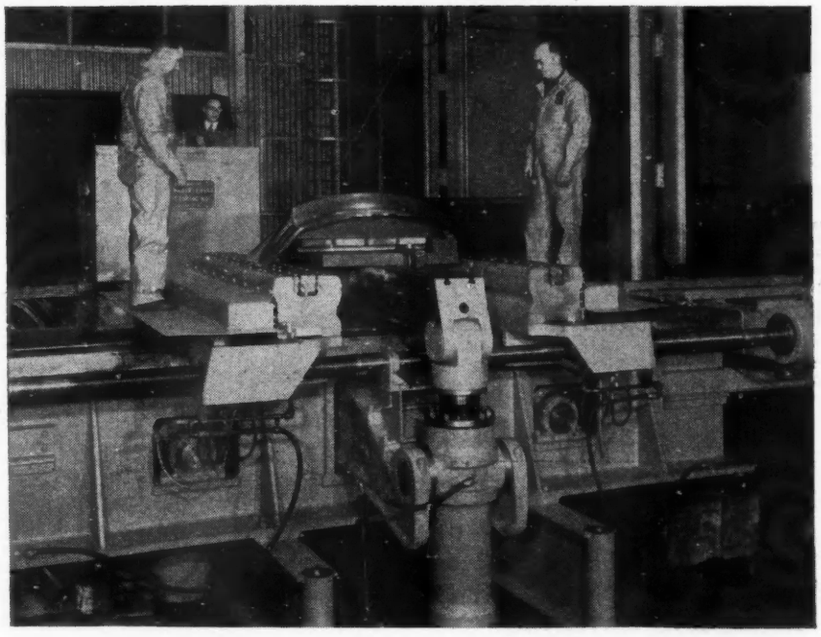
Its versatility is attested not only by the variety of large stampings that can be produced but by the ability to stretch a variety of metals, using inexpensive dies of wood, or wood faced with sheet metal, or Kirksite. This type of press lends itself economically to short run,



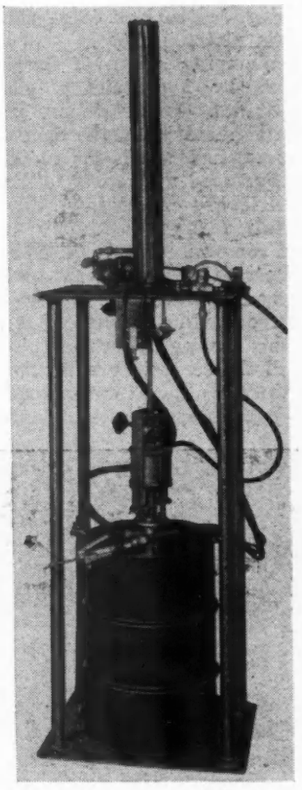
These An-cor-lox cap nuts, made to the user's specifications, are manufactured by the An-cor-lox Division of Laminated Shim Co., Inc., Glenbrook, Conn. A wide choice of materials for the nut body and a considerable variation in the metallic composition of the locking ring insert are offered. The nuts are furnished in all standard sizes.



Designed for slotting 11-gage angle iron, this Wales notching die, manufactured by the Strippit Corp., Buffalo, N. Y., is entirely self-contained.



H-P-M stretching press.



Lincoln pump for pumping viscous material directly from the original container.

job-lot operations, and wherever it can be adapted, provides a ready means for reducing die costs. Moreover, under wartime operations, the stretching press makes it possible to use inexpensive die materials thus relieving the pressure on critical die steels.

The press is of vertical, upward acting, platen type, with overall floor space dimensions of 374 in. x 205 in. The maximum sheet size in steel is 84 in. in width, up to 19 gage.

The main platen (100 in. by 12 in. wide) is raised and lowered by two double-acting hydraulic cylinders, 150 tons total capacity, 24 in. stroke, one located at each end of the platen, and each may be raised or lowered independently of the other. The main platen can be turned 90 degrees and at this position is actuated by two similar cylinders located inside the press frame.

The clamp jaws are traversed by four double-acting hydraulic cylinders, two at each end of the press, having a total pulling capacity of 21 tons and each end has an 18-in. stroke. The return lines on these cylinders are piped through two adjustable pressure relief valves, one for each end. Thus, if the use of a particular die makes it necessary for the clamp jaws to move in toward the main platen during the stretching operation, this movement can be controlled through the relief valves. For positioning the clamp jaws, there are four gear motors, one at each corner, driving threaded shafts. By traversing the jaws with these motors they may be located at any angle (up to their maximum angular adjustment of 15 deg. in the horizontal plane) to the main platen.

The clamping action of the jaws is produced by hydraulically energized toggle joints. To insure the gripping action of these jaws the face of the toggles against which the metal sheet lies is surfaced with a "bead" running the full length of the jaws.

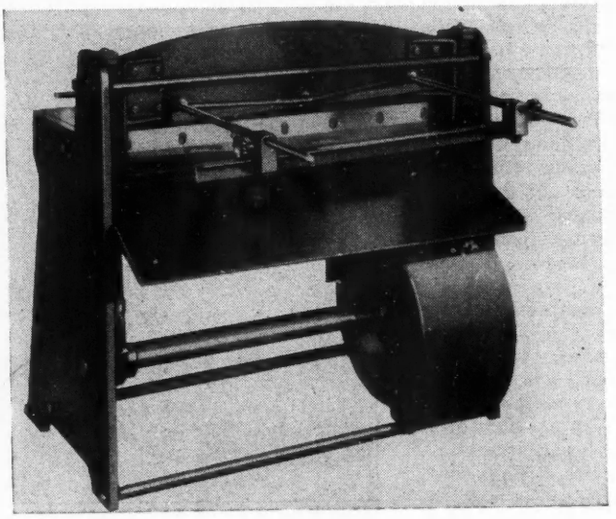
Operation is conveniently handled from a compact control stand on which are located the hand levers and push-buttons controlling the many adjustments required on a press of this type. From his vantage point on this stand, with all the controls practically at his fingertips, the operator can readily see and accurately control the movements of the pressing members.

Pressure is generated for the H-P-M open circuit operating systems by two H-P-M Hydro-Power Radial Pressure Generators and one H-P-M Hydro-Power Gear Pump, all driven by one electric motor. Each of these pumps is part of its own complete operating system, thereby giving individual control to the separate pressing members.

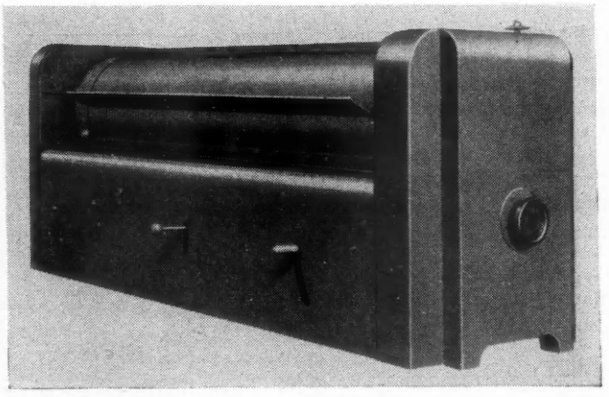
WHITNEY-JENSEN Series No. 72 power squaring shears, built in sizes ranging from 36- to 42-in. cutting lengths, 14- and 16-gage capacities, are offered by the Whitney Metal Tool Co., Rockford, Ill. Cast-steel V-type slide bearings running in cast-iron blocks provide a positive means of adjustment. The back gage, attached to the crosshead, can be set in a parallel position as well as at an angle. Inlaid high-carbon-steel shear blades are furnished as standard equipment; special blades can be supplied on special order.

A NEW dark room printer, Model D-3, recently announced by the C. F. Pease Co., Chicago, Ill., is said to possess all the essentials for successful printing. Providing positive contact, accurate light control, variable speed control, compactness, and adequate speed for all printing operations,

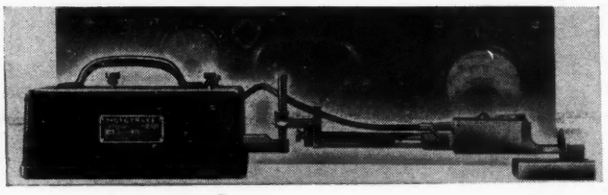
(*Turn to page 72, please*)



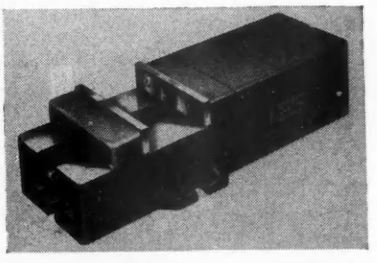
Whitney - Jensen Series No. 72 power squaring shears.



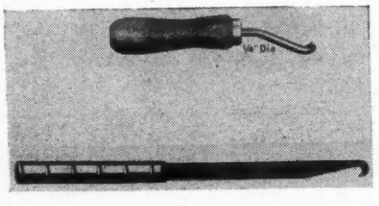
Pease Model D-3 dark room printer provided with wide control over light intensity and and paper speed.



The Mototrace Type V incorporates a new 9-watt driving motor.



This Airlox Senior pneumatic vise was developed to combine the quick action of air with high gripping pressures.



New metal-working tools produced by Aircraft Tools, Inc.

Replacement Parts Schedule

(*Continued from page* 17)

work in process, the average in either of the calendar quarters covered by the order being limited to the quantity required to complete production of the parts permitted in that quarter.

Functional replacement parts as defined in the new order are the engine, clutch, transmission, propeller shaft, universal joint, axle, brakes, wheels, hubs, drums, starting apparatus, spring suspesions, shock absorbers; exhaust cooling, fuel, lubrication and electrical systems including generators, lights and reflectors; gages, speedometers, rear view mirrors, windshield wipers and motors, control mechanisms, and steering apparatus.

Universal joints, shock absorbers and windshield wiper motors have been added to the list of functional parts, they having been omitted from the previous order. Similarly directional signals and flares have been dropped from the list of functional parts.

Due to material shortages the manufacture for replacement purposes of hoods, fenders, running boards, floor mats, bumpers, hub caps, clocks, cigar lighters, window moldings, scuff plates, robe rails, doors, body panels and other non-functional parts is prohibited. A ban on the manufacture of bright work for exterior or interior trim which contains aluminum, chromium, copper, cadmium or nickel has been in effect since limitation order L-69 was issued March 14 to clarify that situation.

Storage batteries are covered in a separate limitation order L-4-b as compared to other replacement parts. This order, effective May 1, prohibits the production of batteries except in specified minimum ampere-hour capacities, reducing the numbers of sizes and models from 75 to 15 and limits production in the six months ending Sept. 30 to 75 per cent of the number of batteries sold during the corresponding period of 1941. This order recognizes the fact that storage batteries deteriorate with age even when not in use, and is much more practical than the previous order which permitted a 300 per cent increase in battery production. Producers' inventories of batteries are limited to a 60-day stock based on the corresponding period of 1941. Jobbers, retailers and warehouses are limited to a 45-day stock based on a similar period of 1941. All purchasers of replacement batteries must turn in a used battery. This limitation order is designed to save substantial amounts of lead, rubber and antimony, the battery industry normally consuming about 27 per cent of the nation's total lead output. Last year 16 million batteries were produced for replacement purposes.

The new order states that no material shall be used which is prohibited or restricted by the "M" orders or other such restrictions upon critical materials. Aluminum is unavailable for engine pistons or any other replacement parts except for brake pistons where substitutes have proved inadequate from a safety factor. However, there is a fairly large stock of aluminum pistons on hand for those makes of cars that use such pistons, although purchasers generally must turn in a worn piston to obtain a new one. Production of exhaust valves for replacement has ceased due to order M-21-d which prohibits the processing of alloy steel containing 4 per cent or more of chromium for any use with lower than A-1-k priority. Exhaust valves require at least 9 per cent chrome content and there is no adequate substitute for it. There are sizable stocks of valves in distributor and factory stocks.

Copper is another critical material that goes into replacement parts. Under limitation order L-106 effective May 6, manufacturers are prohibited to use copper or copper base alloy products for all but essential operating parts of motor vehicles. Listed as essential applications are radiators; cooling system control devices; electrical equipment; tubing and fittings; bearings, bushings, thrust washers and similar parts; carburetor parts such as jets, nozzles, seats, metering rods and floats; plating in connection with carburizing steel; gaskets; certain parts for transmissions and fluid couplings; brazing materials; powdered copper for briquetted bearings; as an alloying element for zinc die castings of fuel pumps, carburetor parts or other functional items where substitutes are prohibitive from the standpoint of tool cost, in ferrous alloys, copper lead bearings and lead base bearings; and miscellaneous parts as tire inner tube valve stems and parts, small stampings in door locks, brush holders of heavy duty truck and bus type, keys and lock tumblers. For radiators the copper content is limited to 71 per cent. Parts for passenger cars, trucks, and school buses affected by this order, the exception being Army and Navy vehicles.

Crude rubber is still available for certain uses, such as storage battery parts, hydraulic brake parts, brake linings and blocks, certain bushings, engine and transmission mountings, windshield wiper blades and sealed beam gaskets. In the latter uses the amount of rubber is limited to 75 per cent of the average monthly consumption in the year ending March 31, 1941. In automotive fan belts the crude rubber content is limited to 30 per cent of the average monthly consumption, but reclaimed rubber has been substituted satisfactorily. The fabric backing made of cotton duck has been a more restricting factor in making fan belts than the rubber itself.

In the production of replacement engine bearings, the supply of cadmium has been cut off, but tin is being substituted when available as an alternate alloy. However, bearing manufacturers are averse to building up too big inventories because they anticipate smaller replacement needs due to less intensive use of motor vehicles.

The more careful operation of cars to make them last and the rationing of gasoline and tires all will tend to bring about the reduced driving of cars and a lesser demand for parts except for some of the nation's older passenger vehicles that must be kept running if the owner is to have transportation. To keep such cars in operation, the new order L-4-c provides that where a replacement part is required for the emergency repair of a vehicle which cannot be operated without such a part, a distributor can file a "Certificate for Emergency Order" with the producer, listing the vehicle's engine and owner. A producer receiving such an emergency certificate must give the order precedence over other non-emergency shipments that might be at hand.

In announcing the new parts order, R. L. Vaniman, deputy chief of the WPB Automotive Branch, laid particular emphasis on the reconditioning and repairing of replacement parts. He urged more reconditioning of engines, rewinding of starters and generators and rebabbitting of connecting rods in order to conserve the nation's supply of replacement parts.

To facilitate the complete conversion of the automotive industry to war production, the WPB will hear appeals from manufacturers for an increase in their parts quota or its transfer to other producerss' quotas. Authority for granting such appeals rests with James S. Knowlson, Director of Industry Operations. Some automobile manufacturers already have experienced difficulty in securing components for certain replacement parts from their suppliers when such suppliers are almost entirely engaged in war production. The high quotas set in the earlier parts order also has handicapped certain companies even when material was available. They have been running their plants two shifts, but it is impossible to meet both military requirements and the big quotas set for civilian replacement parts.

Subcontracting in War Production

(*Continued from page* 37)

The Chrysler Tank Arsenal, which is in volume production of medium tanks, draws on 700 firms in 130 cities located in 20 States, from California to Massachusetts, to furnish the materials, supplies and finished parts.

Among the manufacturers of some of the 30,000 piece parts that go to make up a tank are a heat regulator manufacturer, turning out periscopes; an automobile heater firm, making volute springs for the bogey wheels; a tire manufacturer, fabricating tank tracks; a corn crusher maker, supplying self-laying tracks; and a construction equipment company, providing large steel castings. A plowshare manufacturer, making tank tread forgings, has reversed the old adage by beating plowshares into armaments.

The greatly expanded aircraft program finds hundreds of manufacturers, many of whom did not know a strut from an aileron 18 months ago, now heavily engaged on subcontracts for aviation equipment. A refrigerator manufacturer is turning out propellers, a washing machine firm is making hydraulic gear mechanisms, a pump manufacturer is machining camshafts, a cork product maker is fabricating wing tips, a coal stoker company is producing airplane gears, a farm equipment plant is making tail wing assemblies, a producer of motion picture machines is manufacturing precision equipment and an office equipment firm is making stick assemblies. A goup of gasoline stove manufacturers pooled their facilities to fill a prime contract for rudders and tail surfaces.

Continental Motors Corp., a large producer of aircraft engines, has more than 150 subcontractors, of which two-thirds were old automotive suppliers of the company. Approximately 25 per cent of these companies employ less than 300 men and they range from New England to Cleveland, Chicago and small shops in Detroit. Companies that are willing to undertake subcontracts are thoroughly checked by Continental representatives to see if they have adequate equipment, skilled labor and financial responsibility.

Two Continental follow-up men work with the subcontractors, especially when they are getting into production. They help the subcontractors meet quality standards, particularly on finishes, which are so important in aircraft engine parts. It is impossible to show everything on blueprints, so the follow-up men help interpret them where production problems are involved. Twenty-nine of Continental's new suppliers were located through the Contract Distribution Branch at Detroit. These companies are producing 68 different aircraft engine parts. The Contract Distribution Branch (formerly the Defense Contract Service) in Detroit has staged a display of parts for which subcontractors are sought, for the last nine months. This display was inaugurated last August with the showing of 79 Continental engine parts for which the company sought supply sources due to a big increase in the Government's engine order.

The Detroit exhibit has now grown until it occupies 3200 sq. ft. of floor area in a midtown office building. There are 13 similar exhibits throughout the nation—at St. Louis, Philadelphia, New York City, Los Angeles, Cleveland, Chicago, Atlanta, New Orleans, San Francisco, Memphis, Buffalo, Newark and Boston. About 1000 persons a month visit the Detroit showroom, where they can see samples and blue prints of needed war materials and can talk to prime contractors and War Production Board engineers. Items in the exhibit are constantly changing as new supply sources are found. From 20 to 26 prime contractors keep their vitally needed parts on display.

A typical recent display included tank production parts for American Locomotive Co., bronze bushings for Packard-built aircraft engines, truck transmission gears, balloon hoist gears, airplane and shock struts, carriage and cylinder parts for 37-mm. anti-tank guns, brake drums and axles for heavy trucks.

"We are sales engineers for prime contractors and at the same time agents for subcontractors," says the Michigan director of the Contract Distribution Branch.

The Branch also sends out a bulletin twice a week to a mailing list of 7500 Michigan manufacturers. This bulletin contains a summary of parts on display at the exhibit room, a list of prime contractors and subcontractors wanted, machines, materials and factory space needed or for sale, a complete list of Government items on which bids are open, and other current information of service to Michigan manufacturers in relation to the war program.

Japanese and Italian Military Aircraft

The following descriptions and available performance figures were compiled and released by the British Air Ministry and the United States Army Air Forces. German Military Aircraft appeared in the March 15, 1942 issue of AUTOMOTIVE AND AVIATION INDUSTRIES.

MAKE AND MODEL	TYPE	Crew	TYPE CONSTRUCTION	ARMAMENT	ENGINE: No. Used	ENGINE: No. of Cylinders	ENGINE: Type	ENGINE: Cooling	ENGINE: Hp. at Altitude (Ft.)	DIMENSIONS: Span (Ft.)	DIMENSIONS: Length (Ft.)	DIMENSIONS: Wing Area (Sq. Ft.)	Normal Weight (Lb.)	PERFORMANCE: Maximum Speed at Altitude	PERFORMANCE: Service Ceiling (Ft.)	PERFORMANCE: Range: Miles at Miles per Hour	PERFORMANCE: Range: Hours on Specified Gallonage
JAPANESE				**ARMY**													
Kawasaki....T95	Fighter	1	Biplane, metal covered	3-7.7 mm, f-f-f	1	12	V	LC	800@11500	32.8	26.2	230.0	4000	250@13000	33000	300@210	1.4 on 65
Kawasaki....T97	Fighter	1	L-w monoplane, metal covered	1-7.7 mm, f-f-f; 2-7.7 mm, f-f-w; 1-7.7 mm, m-d	1	14	Rad	A	850@13000	36.0	24.0	141.0	4600	290@15000	32000	335@255	1.31 on 67
Kawasaki....T98	Fighter	1	L-w monoplane, metal covered	2-7.7 mm, f-f-f; 2-20 mm, f-f-w	1	....	....	....	820@10000	29.0	23.0	236.0	5000	270@10000	32000	350@	....
Kawasaki....T97	Bomber	5–7	L-w monoplane	2-25 mm, 1-7.7 mm, f-f-f; 2-7.7 mm, m-d, 1-7.7 mm, m-v	2	....	Rad	A	820@	75.0	62.0	665.0	20900	245@15000	24500	240@210	1.15 on 147[1]
Kawasaki....T97	Light bomber	2	L-w monoplane, ms-sk	2-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	12	....	LC	900@6500	47.7	....	295.0	7000	236@13000	25000	490@206	2.38 on 100
Mitsubishi....T97	Fighter	1	L-w monoplane, metal covered	4-7.7 mm, fixed	1	....	....	A	650@11500	36.0	24.0	140.0	4400	265@13000	29000	275@230	1.63 on 60
Mitsubishi....T98	Bomber	4–5	L-w monoplane, metal covered	2-7.7 mm, f-f-w; 2-mm, m-d; 1-20 mm, m-f-f	2	....	Rad	A	750@15000	75.0	59.0	685.0	21000	220@15000	23000	1180@185	6.40 on 480[2]
Mitsubishi....T97	Light bomber	2	L-w monoplane, ms-sk	2-7.7 mm, f-f-f; 2-7.7 mm, m-d	1	....	Rad	A	800@	40.0	27.0	215.0	5750	260@15000	....	960@220	4.25 on 180[3]
Mitsubishi....T97	Light bomber	2–3	L-w monoplane, metal covered	2-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	14	Rad	A	900@12000	47.7	34.0	295.0	8000	260@13000	27000	750@210	3.30 on 168[4]
Mitsubishi....T98	Light bomber	2–3	L-w monoplane, metal covered	2-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	....	Rad	A	900@ 9000	46.0	26.2	280.0	7800	250@11000	25000	280@208	1.24 on 70[5]
Mitsubishi....T98	Light bomber	2	L-w monoplane, ms-sk	2-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	14	Rad	A	900@10000	39.5	27.9	258.0	....	240@	....	@200	....
Mitsubishi....T97	Bomber	5–7	L-w monoplane, ms-sk	7-7.7 mm; f-f-f, m-d, f-t, f-i	2	14	Rad	A	870@10000	73.0	62.0	675.0	22000	220@10000	22000	1180@190	6.2 on 540[15]
Nakajima....T97	Fighter	1	L-w monoplane, ms-sk	2-7.7 mm, f-f-f	1	9	Rad	A	800@15000	36.0	24.0	140.0	4400	270@15000	33000	340@234	1.45 on 67
Nakajima....T94	Reconnaissance	2	Biplane, fabric covered	1-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	....	Rad	A	600@11000	39.5	26.2	323.0	5720	175@13000	23000	470@150	3.1 on 104
Showa....T99	Fighter bomber	2–3	L-w monoplane, metal covered	1-7.7 mm, f-f-f; 2-20 mm, f-f-w; 1-7.7 mm, m-d	1	....	Rad	A	850@ 5800	50.0	37.0	335.0	9700	220@ 6800	.....	950@180	5.1 on 200[6]
				NAVY													
Aichi....T97	Reconnaissance	2	t-f biplane	1-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	....	....	....	770@13000	42.6	32.5	430.0	5630	180@13000	.....	410@155	2.6 on 120
Aichi (Aichi 104)....T98	Bomber	5	m-w, t-f monoplane, metal covered	4-7.7 mm, f-f-w; 1-can, dorsal; 1-can, f-f-f	3	....	Rad	A	770@13000	87.0	63.0	940.0	26400	230@13000	24000	1000@199	5.0 on 590[7]
Aichi....T98	Reconnaissance	3	Biplane flying boat	1-7.7 mm, f-f-f	....	....	....	....	....	49.2	36.1	160.0	....	Not known		Not known	....
Awanishd....T97	Bomber, reconnaissance	10	Monoplane	....	4	14	Rad	A	900@13000	131.0	81.0	....	45000	215@13000	26000	1500@165	9.0 on 1500[14]
Kawanishi....T94	Reconnaissance	3	t-f biplane, metal tubes fabric covered	1-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	12	....	LC	600@SL	46.0	34.0	530.0	6100	140@ 5000	18000	500@120	4.6 on 120
Kawanishi (Kawa 94)..T97	Torpedo bomber	2	t-f biplane	1-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	12	....	LC	650@ 7000	45.5	38.0	680.0	8000	155@ 7000	....	450@135	3.3 on 120[8]
Mitsubishi....T96	Fighter	1	L-w monoplane, metal covered	2-7.7 mm, f-f-f; 2-7.7 mm, f-f-w	1	....	Rad	A	730@ 9000	36.0	24.5	170.0	4300	250@ 9000	31000	440@217	2.0 on 80
Mitsubishi....T97	Fighter	1	L-w monoplane	2-7.7 mm, f-f-f	1	9	Rad	A	650@ 9000	40.0	25.0	170.0	....	265@11000	30000	590@225	2.6 on 80
Mitsubishi....T96	Dive-bomber	....	Biplane, fabric covered	2-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	9	Rad	A	730@ 7000	37.5	30.8	420.0	5200	200@10000	23000	@155	....
Mitsubishi....T96	Bomber, reconnaissance	4–7	m-w monoplane	7-7.7 mm; f-f-f, m-d, m-v, f-t	2	14	Rad	A	1000@10000	82.0	54.0	800.0	22000	230@10000	24000	950@200	4.75 on 490[9]
Mitsubishi....T96	Bomber, transport	6	Biplane, metal covered	Not known	3	12	V	LC	900@	96.7	70.0	2500.0	38750	145@10000	13000	1400@125	11.25 on 1450[10]
Mitsubishi....T96	Torpedo bomber	2–3	L-w monoplane	1-7.7 mm, f-f-f; 1-mm, m-d	1	....	Rad	A	900@10000	50.8	33.9	375.0	8500	195@10000	23000	470@167	2.8 on 145[11]
Nakajima....T97	Fighter	1	L-w monoplane	1-7.7 mm, f-f-f; 2-7.7 mm, f-f-w	1	....	Rad	A	750@13000	35.5	25.6	160.0	....	270@15000	32000	460@233	1.98 on 80
Nakajima....T96	Torpedo bomber	3	Biplane, fabric covered	1-7.7 mm, m-d	1	....	Rad	A	600@ 8000	49.0	33.0	540.0	7300	168@ 8000	20000	145@145	2.90 on 100[12]
Nakajima....T95	Reconnaissance	2	c-f biplane, fabric covered	1-7.7 mm, f-f-f; 1-7.7 mm, m-d	1	9	Rad	A	600@11000	36.1	27.9	330.0	5800	160@11000	18000	500@135	3.7 on 120[13]
Nakajima....T97	Fighter	2	m-w, t-f monoplane	2-7.7 mm, m-f-f; 2-7.7 mm, m-d	1	....	Rad	A	750@13000	36.8	33.5	185.0	5300	220@13000	27000	325@190	1.71 on 85
ITALIAN				**ARMY OR NAVY**													
Breda....Br 88	Fighter-bomber	3	H-w monoplane	3-12.7 mm, f-f; 2-7.7 mm, wings	2	14	Rad	A	....	....	38.0	358.0	14700	310@13500	28500	900@265	3.38 on 350
Cant....Zi 007	Long-range bomber	4–5	m-w monoplane, wood const.	1-12.7 mm, d-t; 1-12.7 mm, ven; 2-7.7 mm, lat	3	14	Rad	A	1000@13000	81' 4"	60' 0"	740.0	28600	280@15000	26500	800@235	3.4 on 580
Cant....Z506B	Bomber, reconnaissance	4–5	m-w monoplane	1-12.7 mm, d-t; 1-12.7 mm, ven	3	9	Rad	A	780@11500	67' 0"	63' 0"	936.0	26400	230@13000	24000	1000@195	5.0 on 590
Caproni....Ca 312	Torpedo, reconnaissance	3	L-w monoplane, wood and fab. const.	2-7.7 mm, wings; 1-7.7 mm, d-t; 1-7.7 mm, ven	3	9	Rad	A	650@11500	53' 0"	44' 0"	418.0	12800	230@13000	23000	220@195[16]	1.14 on 115
Fiat....G50	Fighter	1	L-w monoplane, ms-sk	2-12.7 mm, f-f; 2-7.7 mm, wings	1	14	Rad	A	840@12500	35' 9"	25' 6"	196.0	5200	290@14500	32000	260@250	1.05 on 57
Fiat....CR42	Fighter	1	Biplane	1-7.7 mm, f-f; 1-12.7 mm, prop. disc	1	14	Rad	A	840@12500	32' 0"	27' 0"	237.0	5100	270@13000	31000	460@232	1.95 on 92
Fiat....Br 20	Bomber	3–6	L-w monoplane, metal covered	1-7.7 mm, f-f; 1-12.7 mm, d-t; 1-7.7 mm, ven	2	14	Rad	A	1000@13000	71' 0"	52' 9"	719.0	22500	255@13000	25000	1150@220	5.2 on 540
Macchi....C200	Fighter	1	L-w monoplane, metal covered	2-12.7 mm, f-f; 2-7.7 mm, wings	1	14	Rad	A	840@12500	35' 0"	27' 0"	161.0	4850	305@15000	33000	280@265	1.05 on 57
Macchi....C202	Fighter	1	L-w monoplane, metal covered	2-12.7 mm, f-f	....	....	....	....	1200@16000	35' 0"	20' 5"	....	6300	330@18000	34000	@300	....
Meridionali....Ro 43	Navy fighter	2	Biplane, metal and fabric covered	1-7.7 mm, f-f; 1-7.7 mm, d-t	1	....	Rad	A	700@ 3000	38' 0"	32' 0"	358.0	5400	186@ 8000	26000	440@155	2.8 on 87
Piaggio....P32	Bomber	4	m-w monoplane, wood const.	1-7.7 mm, f-f; 2-12.7 mm, d-t; 2-12.7 mm, ven	2	14	Rad	A	1000@13000	59' 0"	53' 0"	635.0	22000	260@15000	20000	1100@220	5.0 on 520
Savoia-Marchetti....SM79	Bomber	4–5	L-w monoplane, wood and metal const	3-12.7 mm; 1-7.9 mm	3	....	R	A	780@11500	69' 5"	53' 0"	667.0	22400	260@11500	23000	1000@225	4.5 on 560

Abbreviations for Japanese and Italian Aircraft

(1)—Carrying 4,400 lb. bombs or 1,250 miles carrying 1,100 lb. bombs and 510 gallons of fuel.
(2)—Carrying 2,200 lb. bombs.
(3)—Or 450 miles with 660 lb. bombs and 100 gallons of fuel.
(4)—Carrying 660 lb. bombers, or 500 miles carrying 1,000 lb. bombs and 130 gallons of fuel.
(5)—Carrying 1,230 lb. bombs.
(6)—Carrying 600 lb. bombs, or 880 miles with 2,280 lb. bombs.
(7)—Carrying 2,200 lb. bombs.
(8)—Carrying 1,760 lb. torpedo.
(9)—Carrying 2,200 lb. bombs.
(10)—Carrying 2,000 lb. bombs.
(11)—Carrying 750 lb. bombs or 1,760 lb. torpedo.
(12)—Carrying 1,760 lb. torpedo, or 900 miles with 900 lb. bomb and 180 gallons of fuel.
(13)—Carrying 220 lb. bombs or with 500 lb. bombs and 85 gallons, a range of 320 miles.
(14)—Or with 3,500 lb. bombs a range of 1,450 miles.
(15)—Carrying 4,400 lb. bombs.
(16)—Range as a bomber. As reconnaissance 1000 miles on 195 gallons.

A—Air cooled.
Can—Cannon
c-f—Central float
const.—Construction.
d-t—Dorsal turret
f-f—Forward fuselage
f-f-f—Fixed in forward fuselage
f-f-w—Fixed in forward wings
f-i—Free lateral
f-t—Fixed tail
lat—Lateral
LC—Liquid cooled
L-w—Low winged
m-d—Movable in Dorsal turret
m-f-f—Movable in forward fuselage
mm—Millimeter gun
ms-sk—Metal stressed-skin construction
m-v—Movable in ventral turret
m-w—Mid-wing
prop. disc—Firing through propeller disc
Rad—Radial
SL—Sea Level
t-f—Twin-float
V—Vee Type
ven—Ventral

WHEN a duplicate template is needed at one of its plants, North American's photo-template department has it ready for delivery in approximately one hour. This rapid duplication is made possible by the company's new X-ray process, which was adopted in installing the photo-template reproduction method at the North American Aviation home plant.

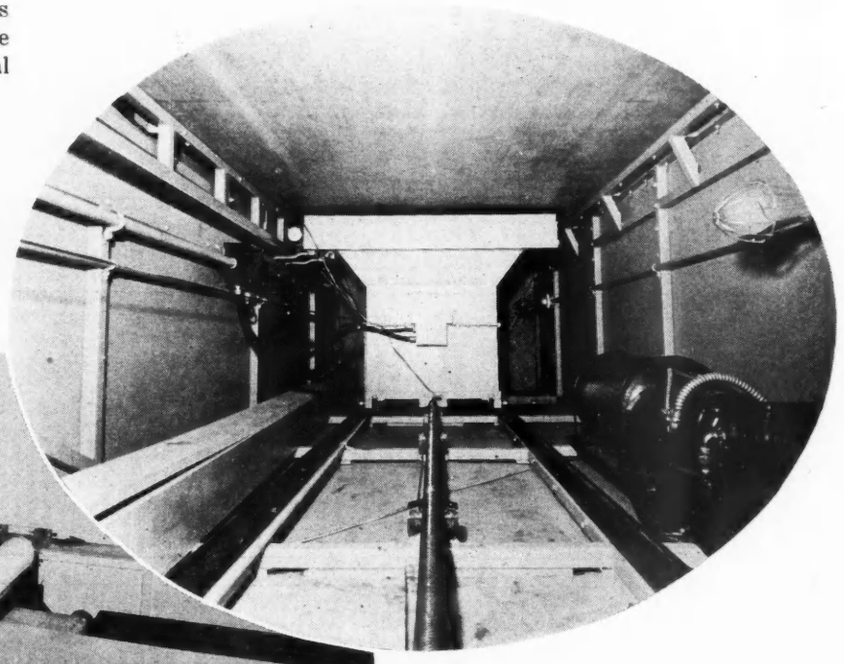
Along with other major aircraft plants, North American Aviation found the job of template duplication an expensive and tedious one. In recent months, with the vast expansion of the industry and the resultant growth of subsidiary plants, there has been an even greater demand than previously for template copies. As a result a great deal of time was involved in making the duplicates for the various decentralized operating units.

The new process in itself is a simple one. On metal sheets that have previously been treated with Eastman Kodak fluorescent lacquer (spec. 20,540) the loftsman scribes the template design. He has a choice of using either a scribing tool, pencil, or pen and ink. Any of these means will destroy the effect of the fluorescent lacquer where the lines have been applied. Then he sends the original layout to the X-ray photo section of the photography department. Here it is placed under the X-ray, which activates the fluorescent surface, causing it to glow. Since the lacquer's effect is destroyed where he has scribed, those lines remain dark. Then any practical surface, coated on one side with Eastman Matte transfer film over a fluorescent lacquer base, is placed next to the original template design, using a vacuum pressure arrangement to hold it firmly. An opaque negative is thus made when the afterglow of the scribed template reacts on the sensitized films. After the transfer process has been completed, the negative is developed by ordinary photographic means, and the finished product is ready to be returned to the lofting department to be cut, trimmed, and sent to the shop for production use.

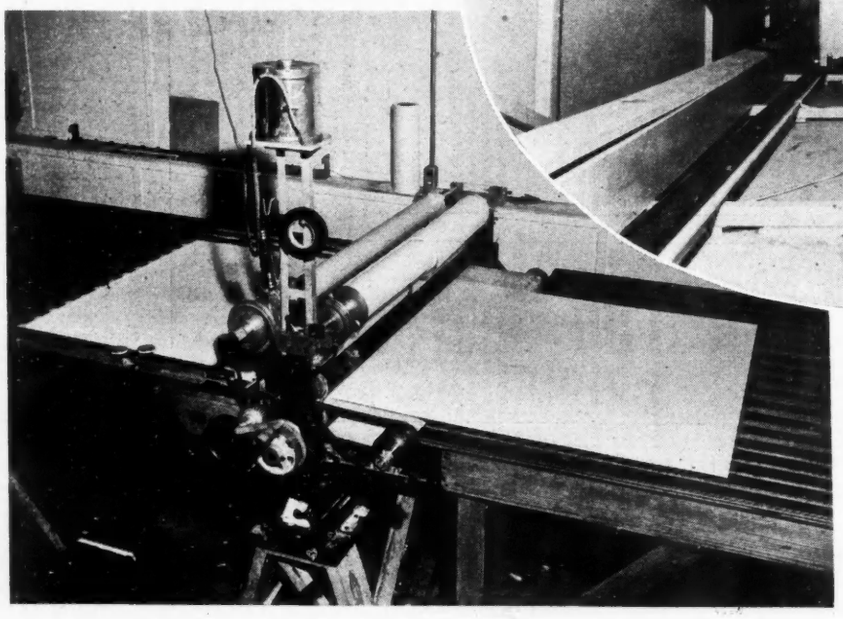
The X-ray photo-template unit at North American is designed to reproduce layouts up to 4 ft. by 8 ft. Anything larger can be done in sections and later spliced together. One-half hour is the minimum time necessary to make a maximum size print.

Philip G. Filmer, director of the Photographic Section of General Motors Corp., with representatives of the Eastman Kodak Co., developed the idea and conducted the original research, and members of the North American photographic and lofting departments worked on the application at the aircraft company.

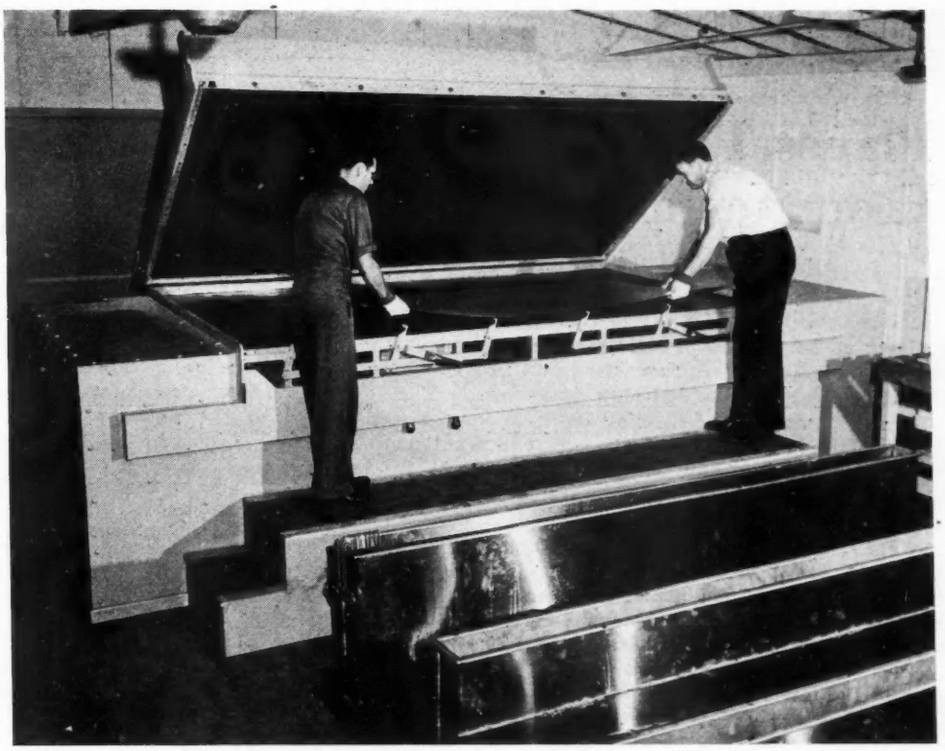
In using the X-ray (which is the General Electric type used in the citrus industry to detect flaws in



(Oval) A view inside the lead-shielded cabinet at the North American photographic department. In the background is the X-ray machine mounted on tracks.



(Left) This laminating machine strips on the transfer film, removing the backing sheet of paper in the same operation.



North American employes are placing a template on the X-ray machine for duplication. When the template is in position, the lid is lowered and the machine turned on. In the foreground are developing tanks.

Duplicating Templates
by the X-Ray Process

North American Aviation uses this new photo-reproduction system to facilitate plant operations. Original research conducted at General Motors photographic laboratories in Detroit with the aid of Eastman experts

fruit), it was imperative that the original templates be coated with a material that would be activated under the X-ray. Filmer called in research men from the Eastman. Together, they tested various emulsions, but each was found to be either not practical from a handling standpoint, or too expensive for quantity use. Finally, after numerous experiments, an especially prepared solution of fluorescent lacquer proved the most economical and efficient. This type of lacquer may be applied to the original template surface with a spray gun.

Any surface, such as wood, glass, metal sheets or composition, may be used in making a surface for the negatives. The surface is first sprayed with fluorescent lacquer if positive prints are required. Then, by using a laminating machine, Eastman Matte transfer film is adhered to the surface over the lacquer. If a negative in mirrored image form can be used satisfactorily, only the film is laminated, eliminating the lacquer base. The Laminator allows the film to adhere to the negative surface, removing the backing sheet of paper in the same operation.

Photographically, Matte transfer film is essentially the same as Eastman super speed stripping film used in graphic arts work. It differs, however, from regular stripping film in that it can be stripped dry from its paper base. The matte transfer film at the present time comes in two widths, 34½ in. and 40 in., and in 50 and 100 ft. lengths.

After the film has been transferred to the surface to be used as a negative, these negative forms are placed in a special curing closet where they are stored. It is possible to use them within 15 min. from the time the transfer has been made, or they may be stored in the curing closet indefinitely.

It is estimated that 50 per cent of the photo-templates are used as negatives, and 50 per cent as positive

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Planes, Parts, Guns Stream From New and Converted Plants

New Bomber Factories in Middle-West Spell Trouble For Axis; Ford, GM, Chrysler, Step Up Production

Back in October, 1940, more than 13 months before Pearl Harbor, the leaders of the automotive industry gathered in Detroit at the behest of Lieut.-Gen. William S. Knudsen, then production chief of the National Defense Advisory Committee, to undertake an industry project of producing medium and long-range bombers for the U. S. Army Air Corps. The Automotive Committee for Air Defense was formed and listed among its members were C. E. Wilson, president of General Motors; Edsel Ford, president of Ford Motor Co.; Alvan Macauley, board chairman of Packard, and K. T. Keller, president of Chrysler. Temporary quarters were set up in the Graham-Paige factory office in Detroit and airframe parts and subassemblies were shipped there from Wright Field for study by engineers from the automotive companies. Brig.-Gen. James H. Doolittle, than a major, was assigned to liaison duty between the Air Corps and the automotive industry.

Now that cooperative industry program is beginning to show results. Airframe parts and subassemblies are starting to flow from the plants of the automotive industry in ever increasing numbers. Four government-financed bomber assembly plants in Fort Worth, Tulsa, Kansas City and Omaha are in production or reaching the production stage. They will help answer President Roosevelt's challenge to the aircraft and automotive industries, when he announced in January that the year's quota was 60,000 airplanes.

But despite these handicaps the program has moved ahead. Fisher Body has been shipping subassemblies for North American B-25 medium bombers for a number of months. Fisher Body bomber production facilities are being expanded and April output was several times greater than in any previous month.

Ford is nearing the stage where complete four-engine B-24 bombers will come off the assembly line at Willow Run as well as shipments of subassemblies to plants in the Southwest. One of the latter plants produced its first B-24 plane 110 days ahead of schedule last month.

At the Willow Run plant, one of the largest industrial buildings in the world, several thousand machines will be required to build the B-24, which contains approximately 300,000 rivets and 188,193 other parts, exclusive of engines. Ford has developed spot welding processes that help speed the con-

(*Please turn to page* 62)

British Combine

American Trucks Arrive in Middle East

American trucks destined for the Middle East are shipped in this knocked-down condition. Upon arrival they are uncrated, assembled, and driven off to the fighting fronts. The truck shown in the photograph is a 1½-ton 4 by 4.

API and SAE Form New Research Council

A new organization, the Cooperative Research Council, sponsored jointly by the SAE and API, has been created to centralize, correlate and promote cooperative research activities of the automotive, aeronautic and petroleum industries. The council formally began operation from its new headquarters in Room 1618, 30 Rockefeller Plaza, New York, on May 1.

The Council consists of 12 members appointed to serve for one year, six representing the SAE and six representing the API. SAE representatives are:

B. B. Bachman, Autocar Co.; J. M. Crawford, Chevrolet Division, General Motors Corp.; William Littlewood, American Airlines, Inc.; J. B. Macauley, Jr., Chrysler Corp.; Arthur Nutt, Wright Aeronautical Corp.; C. G. A. Rosen, Caterpillar Tractor Co.

The API representatives are:

D. P. Barnard, Standard Oil Co. (Indiana); A. L. Clayden, Sun Oil Co.; T. G. Delbridge, The Atlantic Refining Co.; R. A. Halloran, Standard Oil Co. of California; K. G. Mackenzie, The Texas Co.; G. G. Oberfell, Phillips Petroleum Co.

At the organization meeting of the council on April 13, B. B. Bachman was elected chairman, and T. G. Delbridge, vice-chairman. C. B. Veal, for 16 years SAE research manager and secretary of the Cooperative Fuel Research Committee, has been appointed secretary of the council, and R. P. Anderson, secretary, General Committee, Division of Refining of the API, has been named treasurer.

Wheeler Joins WPB

Walter H. Wheeler, Jr., has been appointed New England Regional Director of the War Production Board, He was formerly chief of the contract distribution branch of the production division.

U. S. to Buy Tires, Tubes from Car Users

A plan whereby the Defense Supplies Corp. would be granted $150 millions by the government for the purchase of new or used tires and tubes held by American automobile owners has been revealed through the office of Secretary Jesse Jones. This money would supplement the plan already announced to finance to the extent of $75 million the frozen stock of new passenger car tires and tubes held by manufacturers, distributors and dealers. Under the plan users will be paid in bonds, stamps or cash if they dispose of spare rubber to the government.

GM Union Case in Hands of Labor Board

Negotiations Fail to Effect Renewal of Contract Temporarily Extended by WLB; Other Unions Sign New Agreements

Stormy sessions marked the opening hearings by the War Labor Board of the deadlocked contract negotiations between General Motors Corp. and the UAW-CIO. The case was ceritfied to the WLB in Washington by James F. Dewey, federal conciliator, on April 28, after more than five weeks of negotiations failed to bring about a renewal of the contract. The contract expired April 28, but both parties agreed to keep it in effect until the Labor Board hands down a decision, with any wage adjustments retroactive to April 28. Chief causes of the deadlock have been the union demands for a closed shop, $1 a day wage raise and a bonus of a $100 defense bond, costing $75, for each worker in lieu of vacations.

In temporarily extending the contract, the WLB ordered GM to continue paying double time for Sunday work through May 18, although the UAW-CIO at an emergency war conference in Detroit early in April voted to waive double time for regular Sunday work for the duration. C. E. Wilson, president of GM, charged that the board's action in continuing double Sunday pay resulted from "ex parte" hearings at which the corporation was not represented. This was angrily denied by William H. Davis, chairman of WLB, who said that GM had been represented and that the corporation's charges cast reflections upon the integrity of the board's members. GM finally yielded on the Sunday pay issue and Wilson acknowledged that it had not been the corporation's intention to cast aspersions upon the board.

GM also had asked that all the hearings before the WLB, including those before a three-man mediation panel that will endeavor to find a formula to solve the dispute, be open to the press and public. The WLB voted unanimously to make the general hearings public but to keep the mediation hearings private in order to reach a more orderly settlement of the issues at stake. The mediation panel is composed of Fowler V. Harper, Indiana University law professor; Wilbur Doran, vice-president of Metropolitan Edison Co., Reading, Pa., and Patrick Fagan, president of District No. 5, UMW, Pittsburgh. This panel was to take up first the Sunday pay issue by adapting the principles reached in the recent International Harvester case, decided by the WLB April 15, to the 85 plants of GM. This provides for time and one-half pay for work beyond the 40-hour week and double time for work on the seventh consecutive day but no double time for Sunday work "per se."

The International Harvester case also may set the pattern for GM in the union maintenance of membership provision which the board granted in lieu of the closed shop. Under this contract clause union members must remain in good standing by payment of dues as a condition of employment. However, those wishing to resign from the union may do so before the contract takes effect and non-union employes are not required to join the union.

In agreeing to this "freezing" of union membership for the duration, International Harvester Co. stated, "We are convinced of the soundness of the WLB conclusion that union maintenance will advance the cause of war production. It appears to us that the unrest and disturbance of war production over the months of the defense period were not due to the lack of union security plans in industry but were principally caused by the intensified organizing efforts of the unions." The FEWOC-CIO and two AFL unions had been campaigning for members in eight International Harvester plants. International Harvester is skeptical of the maintenance of membership formula as a solution unless the unions discontinue "pressure" campaigns to gain new members.

Demands of the UAW-CIO for 13 changes in the closed shop contract with the Ford Motor Co., which comes up for revision June 20, were met with a counter demand by Harry H. Bennett, Ford personnel director, that all Ford

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OPA to Ration All Types Of Tires for Every Purpose

Authority to ration all types of tires, including synthetic, for all purposes, including industrial equipment, has been delegated to the Office of Price Administration by the War Production Board. Under previous delegations of authority by the WPB, the OPA had power to ration tires for commercial as well as passenger use, but some confusion existed as to the jurisdiction over tires for certain types of industrial equipment. The new regulation (Amendment No. 1 to Supplementary Directive 1-B) makes clear that power to ration this type of tire resides in the OPA.

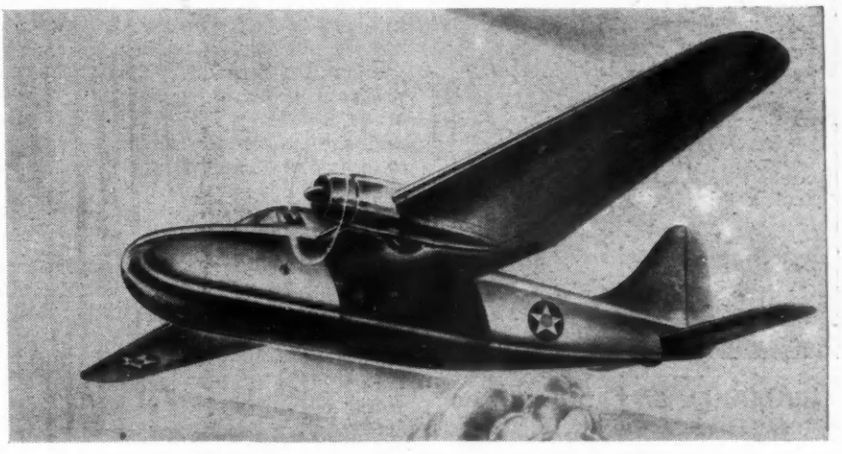
Ordnance Contracts

Contracts totaling $1,896,543,923 were placed by the Detroit Ordnance District in the three months ending April 9. Total orders placed in the district which embraces the lower peninsula of Michigan, totaled $2,624,945,871 as of the latter date, according to Col. R. Z. Crane, deputy chief of the district. The district contains a large segment of the automobile industry and is the largest ordnance district in the U. S. In January 230 new contracts were placed totaling $971,358,042.

In 1938 the Detroit Ordnance District numbered a personnel of three members. Now there are nearly 4000 employes spread over seven floors of three Detroit office buildings.

Construct Parts Plant

N. A. Woodworth Co. has begun construction on a $2-million addition to its plant at Ferndale, Mich. The company is a large producer of aircraft engine parts for the Wright Aeronautical Co. plant at Lockland, Ohio.



New C-76 Saves Strategic Materials

Hailed as one solution to the problem of building military aircraft from non-strategic materials, the Curtiss C-76, shown here as an artist's conception, is constructed largely of wood. The new twin-engined plane, said to be about the size of a modern all-metal domestic transport, will be built "somewhere in Kentucky." It will be used as a personnel and military cargo transport.

WPB Corrals More Steel-Making Capacity

Latest Orders, by Cutting Uses for Civilian Production, Allot Even More Steel to Armament Needs

By W. C. Hirsch

Steel market activities reflect more and more the rapid approach of the time when none but A-1 rating business will be of interest to mills. In fact, orders in the top preference category are subjected to constant re-examination with a view to giving the most important of the Army, Navy, and Lend-Lease needs the right of way over what can be postponed without quite so grave a risk. And, of course, the total tonnage scheduled for rolling for these three war services has to be held within the limits of available raw material and, in the case of many products, of mechanical capacity as well.

Sheet and strip mills, which formerly depended for orders chiefly on the requirements of automobile manufacturers, are now 100 per cent engaged in the production of material for direct war needs, such as Army trucks, jeeps, bomb fins, etc., with considerable of their capacity converted for the rolling of plates needed to overcome the dents made into the shipping tonnage by submarine warfare.

Announcement by the War Production Board of a purge of permissible steel products for civilian use to the extent of some four hundred various items serves to quicken the public's understanding of the seriousness of the situation and to intensify the quest of hundreds of smaller manufacturers for a place in the war program. While war-time regulations are not intended to be painless to business, they are not inflexible and, if future developments make it safe to divert a greater part of the steel-making capacity to less pressing needs, it may be assumed that easing of restrictions will follow in due course. But as long as the present critical situation continues, further tightening of the rules rather than their modification must be expected.

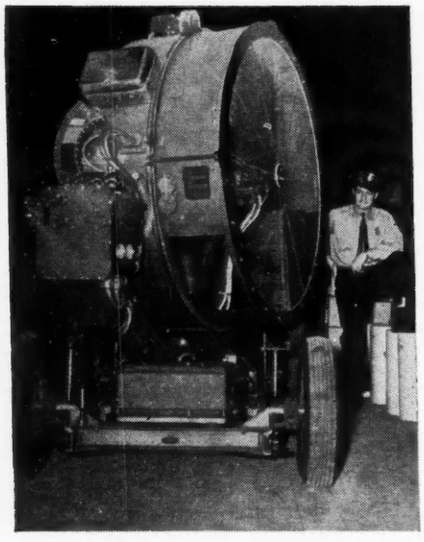
To the end of accelerating steel output for war needs, the authorities are doing everything to bring from Lake Superior ports to furnaces upwards of 90 million gross tons of ore, compared with approximately 80 million tons last year. So important is this task that all Great Lakes grain traffic has been suspended for the time being, to give the ore carriers clear sailing. At the same time every nook and corner, where scrap might have accumulated, is being searched and, where necessary, compulsory disposal by the owners resorted to.

Investigation of a Hoboken dock the other day yielded a goodly quantity of scrap that was lying idle. Many thousand dollars' worth of tool steel scrap has been made available in the last few weeks through the scrapping of dies in automobile plants. In short, nothing is being left undone to insure as large a supply of steel-making materials against the day when weather conditions and transportation congestion may enhance the difficulties of shippers and consignees.

Metals Reserve Co., the Government's agency for procuring non-ferrous metals for the war effort, has formed the Copper Recovery Corp. to carry out a program of salvaging domestic copper scrap on a large scale. Zinc will come under complete allocation control beginning June 1. Governent control over beryllium imports has been tightened.

Australia, which with the closing of the Malayan and Dutch East Indies markets to American consumers has moved into the front ranks of tin-producing countries that might become a potential source of supply for us, has decided to expand its output by raising the price to £371 a gross ton, an increase of £51. £10 a ton will be allocated to a pool to develop low-grade mines.

The OPA has sanctioned an increase of $15 a gross ton in the price of ferromanganese to $135, f. o. b. Atlantic seaboard. Formal price ceilings have been decreed for fluorspar, important as a fluxing material in steel-making.



800,000,000 Candlepower

The Murray Corp. of America, almost completely converted to war production, has been given a large contract for the quantity output of this type of anti-aircraft searchlight. By substituting steel stampings for the aluminum formerly used in many parts, Murray engineers expect to save more than 100,000 pounds of aluminum a month.

Goodrich Aids Cornell In Rubber Research

Emphasizing that "America's critical rubber problem today can be met only with all-out conservation of the rubber now in use," John L. Collyer, president of The B. F. Goodrich Co., has announced that his company is providing financial aid to Cornell University in seeking a long-term solution to the problem through possible new botanical sources of rubber in the Western Hemisphere.

Ford Sells Plants

Ford Motor Co. has sold two more of its branch assembly plants, those at Des Moines, Iowa, and St. Louis, to the Government. The Defense Plant Corp. will lease the Des Moines plant to the Solar Aircraft Co., which will operate it as a branch of its main factory at San Diego, Cal. Previously, Ford has sold branches at Indianapolis, Charlotte, N. C., and Seattle in the last 18 months.

D-N-X to Make Diesels

The D-N-X Engine Corp., a wholly owned subsidiary of the Hercules Motor Corp. of Canton, Ohio, has leased the Buffalo plant of the Ford Motor Co. to manufacture diesel engines for the Navy.

Adel Awards Prizes

Thirty-seven cash awards totaling $2,950 have been distributed to employees of Adel Precision Products Corp., Los Angeles, Cal., for suggestions which improve production methods in the aircraft equipment factory.

William Fleming

William Flemming, Sr., 61, president of the Shaler Co., Waupun, Wis., died at his home April 29, a few hours after having suffered a heart attack.

CALENDAR

Conventions and Meetings

Natl. Metal Trade Association, Annual Convention, New York City, May 19-20
American Iron & Steel Institute New York City—Annual Mtg.....May 21
American Society of Mechanical Engineers, Semi-Annual Meeting, Cleveland, Ohio .....June 8-10
Eastern Photoelasticity Conference Boston .....June 20
Automotive Engine Rebuilders Assoc., Cleveland, Ohio. .....June 22-24
American Society for Testing Materials, Atlantic City, Annual Mtg...June 22-26
National Petroleum Association, Atlantic City, Annual Mtg.....Sept. 16-18
Natl. Metal Congress & Exposition, Detroit .....Oct. 12-17
American Society for Metals, Detroit, Annual Mtg. .....Oct. 12
American Welding Society, Detroit, Annual Mtg. .....Oct. 12

5 service points speed ADEL'S war deliveries

The zooming aircraft production picture with tremendous inland branch plants plus the world-famous productive genius of the now converted automotive industry finds ADEL keeping pace with new sources of supply and engineering counsel. With 3,000 types and sizes of line support, hydraulic and anti-icing equipment in mass production and deliveries up several hundred per cent, we are proud to be doing our share to speed the day that more and more T.N.T. blasts Tokyo!

ADEL

BURBANK, CALIF.

QUALIFIED ENGINEERS CONNECTED WITH WAR PRODUCTION MAY OBTAIN PRECISE LOCATIONS ABOVE INDICATED BY CONTACTING OUR BURBANK HEADQUARTERS

Press Ass'n, Inc.

Newest Bomber Trainer

While flying in bomber trainers such as this Beech AT-11, fledging bomber crews preparing for service in regulation bombers acquire the "know how" at the Midland, Texas, Army Flying School. A twin-engined, low-wing monoplane, the plane carries small practice bombs for bombardier training.

Suggests Plan to Scrap Automobile Dies

Weymouth, WPB Industrial Salvage Head, Hints at Plan to Get Nickel Scrap; Modifies Position in Later Statement

After stating at a WPB Salvage Section meeting in Detroit that the automotive industry would be asked to scrap $60 million worth of 1942-model automobile dies to provide nickel steel scrap for the war program, George Weymouth, chief of the industrial salvage section of the WPB, modified his position later in an official statement issued in New York.

Weymouth's statement said:

"There are many problems involved before the automotive dies and molds can be considered for salvage purposes. The whole matter is a question of broad policy, governmental and otherwise, affecting war-time transportation and post-war employment, which must be given careful consideration. The decision as to the use of this production equipment must be withheld until many factors are analyzed. No orders as to the disposition of 1942 automotive tools and dies have been issued. I have no figures to release whatsoever on the amount of scrap involved in automotive dies and molds. There is no official figure available, nor can one be given until an extensive study is made.

It is presumed that Weymouth overstepped his authority in his original assertion that the dies would be sought immediately for scrap. Such a decision probably would have to come from Donald M. Nelson, chief of WPB, after conferences with the automotive companies involved. The Automotive Council for War Production was not approached on the matter by Weymouth.

Scrapping of 1942 automotive dies might mean a year's unemployment for 400,000 or more former automotive workers after the war ends. New models would have to be designed to replace the '42 models and then the complete tooling and die making job would have to be undertaken. In addition, automotive machinery and facilities would have to be brought together from their war operations and put in working order for the resumption of automobile production. The latter period will have to be gone through, anyway, even with 1942 dies maintained intact, but with the dies available it might be accomplished in three to six months. Without any dies to start with, a year to 18 months might elapse before automobile factories would be in production again.

More Field Managers

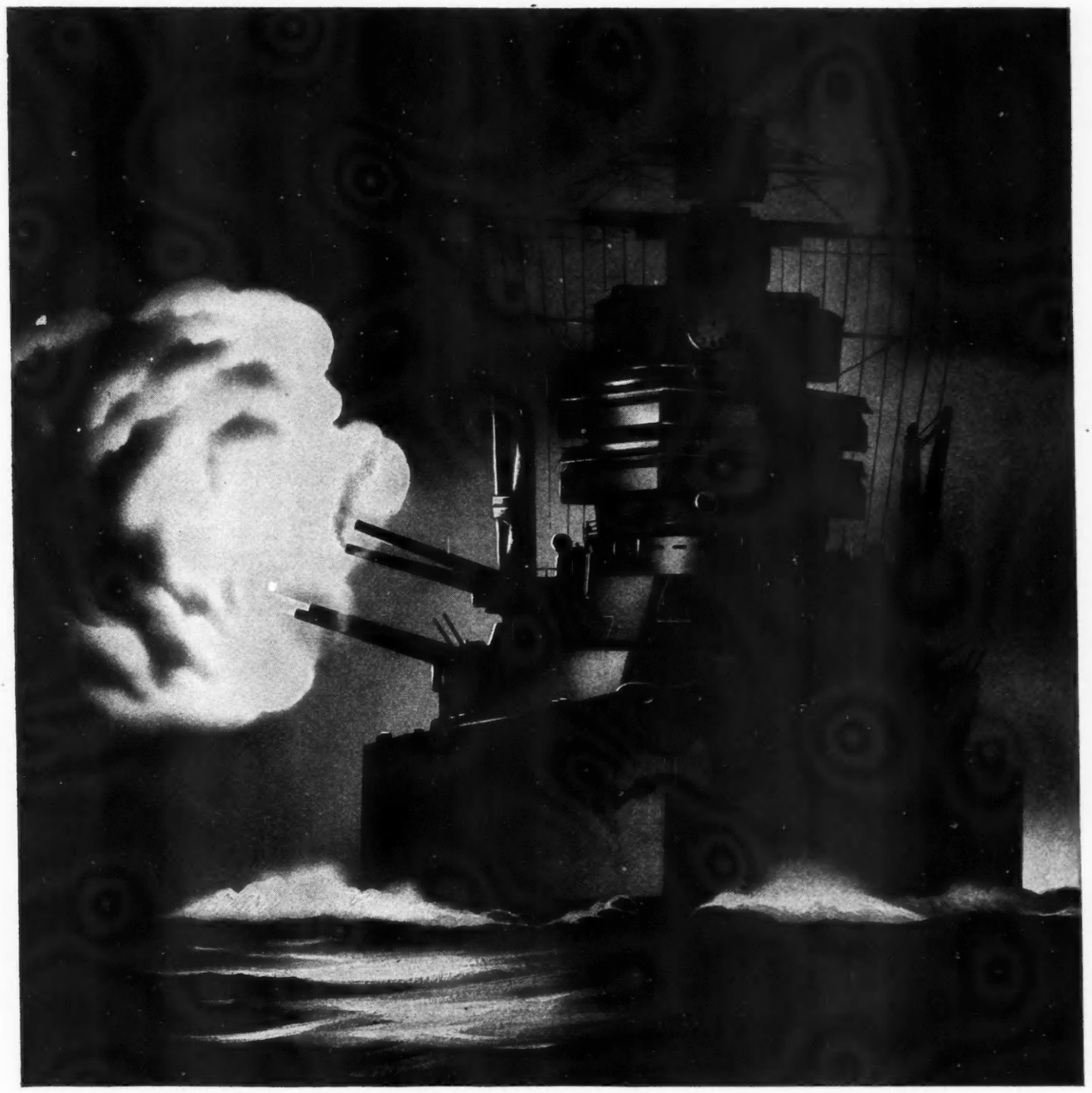
Joseph B. Eastman, Director of the Office of Defense Transportation, has appointed nine more field office managers in the Division of Motor Transport.

These field officers will administer locally the various programs being conducted by the Division of Motor Transport. Their duties will also include assisting in coordination and mobilization of motor vehicle equipment to meet wartime conditions, clearing emergency transport movements with State and local authorities, and maintaining liaison among Government agencies. Location of the new field offices and the managers appointed follow:

Detroit, Mich.—J. Robert Cooper, former traffic manager of the Red Star Transit Co., Detroit; Los Angeles, Calif.—Roy Long, former vice-president of the Valley Motor Lines and assistant general manager of the Valley Express Co.; St. Louis, Mo.—A. D. Mason, former vice-president and general manager of the St. Louis terminal of Complete Auto Transit; Baltimore, Md.—M. R. Greene, former manager of the Ericsson Line, Inc.; Philadelphia, Pa.—Everett Harding, former traffic manager of Horlacker Delivery Service and Highway Express; Louisville, Ky.—F. S. Crawford, former president of the Crawford Transport Co., Ashland, Ky.; Memphis, Tenn. — R. T. Lawrence, former officer of Gordon's Transports, Inc.; New Orleans, La.—Donald T. Maentz, former manager of the Associated Truck Lines, Inc., Grand Rapids, Mich.; Seattle, Wash.—Harold C. Arnot, former automotive distributor.

New Passenger Car Registrations

	FEBRUARY 1942	JANUARY 1942	FEBRUARY 1941	TWO MONTHS 1942	TWO MONTHS 1941	TWO MONTHS Per Cent Loss	Per Cent of Total Two Months 1942	Per Cent of Total Two Months 1941	FIVE MONTHS MODEL YEAR 1942	FIVE MONTHS MODEL YEAR 1941	FIVE MONTHS MODEL YEAR Per Cent Loss
Chevrolet	4,457	13,922	73,488	18,379	144,427	87.2	21.94	24.19	129,576	376,322	65.6
Ford	3,062	9,918	54,088	12,980	104,877	87.8	15.49	17.56	91,363	247,860	63.1
Plymouth	2,181	7,876	34,502	10,057	69,711	85.6	12.00	11.67	68,171	186,301	63.4
Buick	1,537	5,643	24,391	7,180	50,652	85.6	8.57	8.48	49,433	139,644	64.6
Pontiac	1,365	4,714	23,759	6,079	46,074	87.0	7.26	7.71	48,132	117,610	60.7
Oldsmobile	1,229	3,764	19,604	4,993	38,850	87.0	5.96	6.50	35,057	75,466	53.5
Dodge	1,021	3,943	15,176	4,964	31,824	84.5	5.93	5.33	35,864	99,104	63.8
Studebaker	775	2,710	7,530	3,485	15,521	77.6	4.16	2.60	19,873	42,138	53.1
Chrysler	573	2,169	10,404	2,742	21,204	87.0	3.27	3.55	22,240	48,813	54.5
Hudson	487	1,679	5,156	2,166	10,540	79.3	2.59	1.76	12,386	30,869	60.0
Nash	465	1,689	6,594	2,154	12,201	82.0	2.57	2.04	13,362	25,326	47.2
Packard	396	1,593	4,082	1,989	8,576	76.8	2.37	1.44	17,468	27,113	35.6
De Soto	399	1,544	6,023	1,943	12,155	84.0	2.32	2.04	14,155	30,074	52.8
Mercury	403	1,534	6,824	1,937	13,884	86.1	2.31	2.32	14,155	33,479	57.7
Cadillac	513	1,005	4,685	1,518	9,830	84.6	1.81	1.65	11,077	23,709	53.5
Lincoln	190	472	1,544	662	3,183	79.3	.79	.53	3,983	8,646	53.9
Willys-Americar	102	373	1,497	475	2,985	84.0	.57	.50	3,305	7,831	57.8
Crosley	22	53	26	75	68	+10.0	.09	.01	405	179	+126.0
Miscellaneous		2	328	2	697			12	195	2,473	92.2
Total	19,177	64,603	299,701	83,780	597,259	85.9	100.00	100.00	588,200	1,523,257	61.4
Chrysler Corp.	4,174	15,532	66,105	19,706	134,894	85.9	23.52	22.58	139,623	340,654	59.0
Ford Motor Co.	3,655	11,924	62,456	15,579	121,944	87.3	18.60	20.42	109,501	289,985	62.2
General Motors Corp.	9,101	29,048	145,927	38,149	289,833	86.7	45.53	48.53	272,082	756,389	64.0
All Others	2,247	8,099	25,213	10,346	50,588	79.6	12.35	8.47	66,994	136,229	50.9



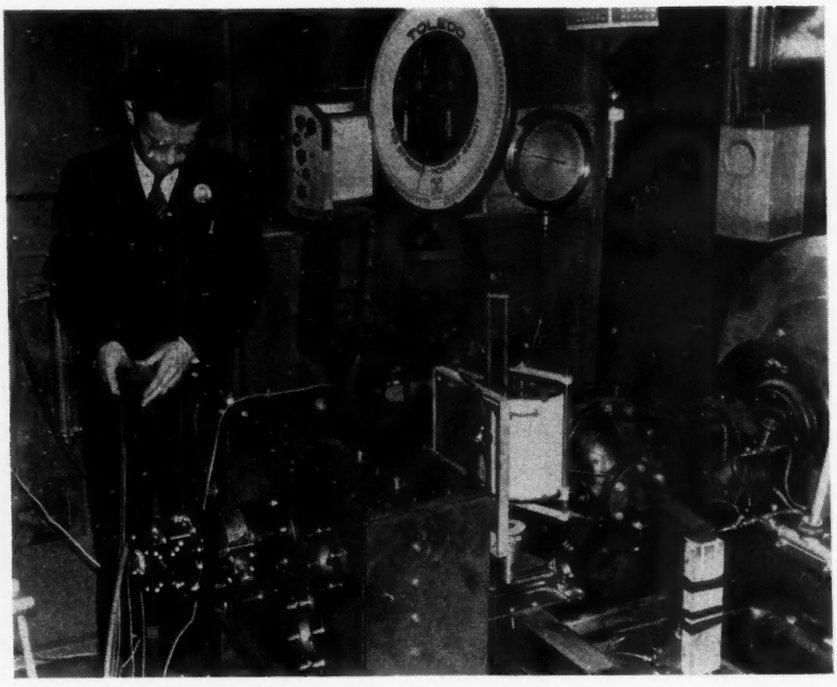
MOLYBDENUM ENLISTS FOR THE DURATION

The enormous increase in requirements of molybdenum has necessitated the War Production Board Order M-110, placing molybdenum consumption under allocation control...Our metallurgical research staff is fully engaged in war work. At our mine, mill and converting plant, every effort is being made towards maximum production.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • CALCIUM MOLYBDATE

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY



Aircraft Starter Tester

This machine, recently perfected by Wright Field engineers for the testing of airplane engine starters, simulates the pressure and propeller inertia of any type of aircraft engine. Propeller inertia is varied by placing steel discs of different weights on the drive shaft (extreme right). Pressure is varied by a hydraulic pump connected to a hydraulic brake drum. The housing at the left of this Prony brake rig is built to accommodate four starters at one time.

Build Wooden Tires

Wooden tires for use on automobiles or horse-drawn vehicles are being made in the Buffalo, N. Y., plant of the Arrow Tank Co., Inc. Two Buffalo companies already have started using these wooden tires experimentally.

Developed from wedge-shaped blocks of elm, about 14 pieces are needed for a complete tire, which is built onto the steel rim of a wheel. There are interlocking connections between each block and the complete tire is held together by a steel band sunk into the outside edge. No glue is used in the fabrication of this unit.

Set Gasoline Prices

Motor fuel prices at all service stations throughout the country—with the exception of 17 East Coast States and the District of Columbia—have been placed under a ceiling based on the highest prices charged by each individual seller during March, 1942. They become effective May 18, 1942.

In the East Coast area, stations will be allowed to charge the highest prices prevailing during March, 1942, plus 0.4-cent per gal. for gasoline and 0.2-cent per gal. for Diesel fuel. These increases will be allowed because of the greater cost of tank-car haulage.

New Truck Registrations

	February 1942	January 1942	February 1941	TWO MONTHS 1942	TWO MONTHS 1941	TWO MONTHS Per Cent Loss	Per Cent of Total Two Months 1942	Per Cent of Total Two Months 1941
Chevrolet	2,691	6,829	15,778	9,520	31,579	68.8	28.29	31.29
Ford	2,620	6,559	16,531	9,179	32,328	71.6	27.26	32.02
International	2,020	3,604	6,992	5,624	14,437	61.0	16.70	14.31
Dodge	1,143	2,616	4,141	3,759	8,637	56.5	11.17	8.56
G. M. C.	817	1,778	3,118	2,595	6,506	60.0	7.71	6.44
White	249	463	658	712	1,320	46.1	2.11	1.31
Mack	142	352	532	494	1,205	59.0	1.47	1.19
Diamond T	142	272	436	414	883	53.2	1.23	.87
Studebaker	94	176	231	270	462	41.6	.80	.46
Autocar	65	128	139	193	328	41.2	.57	.32
Divco	67	104	154	171	299	42.8	.51	.30
Federal	32	100	136	136	256	46.9	.40	.25
Reo	37	77	90	114	169	32.5	.34	.17
Brockway	47	65	128	112	283	60.4	.33	.28
Plymouth	37	62	747	99	1,613	94.0	.29	1.60
Willys-Americar	25	63	82	88	164	46.3	.26	.16
F. W. D.	10	26	23	36	38	5.3	.11	.04
Hudson	8	21	63	29	128	77.3	.09	.13
Sterling	12	15	35	27	69	60.9	.08	.07
Miscellaneous	49	46	110	95	250	62.0	.28	.23
	10,311	23,356	50,124	33,667	100,954	66.3	100.00	100.00

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Relatively stable levels of general business activity are currently reported. The index of *The Journal of Commerce*, without adjustment for seasonal variation, for the week ended May 2 stands provisionally at 120.5 per cent of the 1927-29 average, one fractional point below the figure for the preceding week. The adjusted index of *The New York Times* for the week ended April 25 was 133.2 per cent of the estimated normal, as against 132.6 a week earlier and 120.5 a year ago.

Department store sales during the week ended May 2, as reported by the Federal Reserve Board, were 8 per cent above those a year ago. For the four weeks then ended, the similar gain was 5 per cent, with total sales in 1942 to that date 21 per cent greater than the comparable value last year.

Railway freight loadings during the week ended May 2 totaled 858,904 cars, 0.3 per cent fewer than the number for the preceding week, but 8.1 per cent greater than the figure a year ago.

Bank debits in leading centers during the thirteen weeks ended April 29 were 12 per cent more than the total a year earlier. The increase outside New York City was 18 per cent.

Electric power output increased contra-seasonally in the week ended May 2 and was 12.2 per cent above that a year ago, as against a corresponding gain of 10.9 per cent recorded for the week before.

Crude oil production in the same period averaged 3,335,000 barrels daily, 246,350 barrels below the figure for the preceding week and 331,350 barrels less than the average recommended by the Office of the Petroleum Coordinator for April.

Business failures in the final week of April numbered 199, according to the Dun & Bradstreet report, as compared with 233 a week earlier and 272 a year ago. The four-month total in 1942 fell 16 per cent below the comparable number last year.

Engineering construction contracts awarded during the week ended May 7 totaled $434,955,000, an all-time peak equal to six times the corresponding sum last year; and the total so far in 1942 is 64 per cent greater than the comparable amount a year earlier, according to *Engineering News-Record*.

Professor Fisher's index of wholesale commodity prices for the week ended May 1 stands at 106.5 per cent of the 1926 average, as compared with 106.3 for the preceding week and 89.9 a year ago.

Member bank reserves dropped $218 million during the week ended May 6, and estimated excess reserves declined $130 million to a total of $2690 million.

Turney Is Conservation Head

John R. Turney has been appointed director of the newly created Division of Transport Conservation to administer the extended authority over highway transportation. Henry F. McCarthy has succeeded Turney as director of the Division of Traffic Movement of ODT.

IT WON'T BUDGE!

GASOLINE, KEROSENE, FUEL OIL, HOT LUBRICATING OIL, HOT WATER, SALT WATER, ANTI-FREEZE SOLUTION . . . NONE OF THESE LIQUIDS WILL MAKE A FILM OF FORM-A-GASKET MOVE FROM POSITION, MELT OR DISSOLVE!

Permatex Form-A-Gasket used in automobile and aircraft engines is available in three types.

FORM-A-GASKET NUMBER 1 IS A PASTE THAT DRIES FAST AND SETS HARD.

FORM-A-GASKET NUMBER 2 IS A PASTE THAT DRIES SLOWLY AND REMAINS PLIABLE.

AVIATION FORM-A-GASKET IS A HEAVY LIQUID THAT SETS QUICKLY AND DOES NOT DRY.

These three Form-A-Gasket products are used in many industries wherever leakproof, pressure-tight flange unions, gasket assemblies or screw thread connections are required.

PERMATEX COMPANY, INC.
Sheepshead Bay, N.Y., U.S.A.

International

Marine Air Transport

The development of facilities for air transport of troops and materials is becoming a major consideration of the armed forces. The 37-mm anti-tank gun shown being unloaded by the Marines is a somewhat small piece of equipment compared to the small gun-towing car which was also carried in the plane.

Passenger Car and Truck Production *(U. S. and Canada)*

	March 1942	February 1942	March 1941	THREE MONTHS 1942	THREE MONTHS 1941	Per Cent Change
Passenger Car Production:						
United States Plants	6,216	52,200	410,196	206,274	1,215,942	−82.3
Canadian Plants	3,192	3,989	12,093	11,430	34,730	−67.0
Total	9,408	56,189	422,289	217,704	1,250,672	−82.6
Truck Production:						
United States Plants	88,294	81,934	97,638	260,631	278,392	− 6.3
Canadian Plants	16,996	16,192	13,951	50,690	38,219	+32.8
Total	105,290	98,126	111,589	311,321	316,611	− 1.8
Total—United States Plants	94,510	134,134	507,834	466,905	1,494,334	−68.7
Total—Canadian Plants	20,188	20,181	26,044	62,120	72,949	−14.6
Total—Cars and Trucks—U. S. and Canada	114,698	154,315	533,878	529,025	1,567,283	−66.2

Monthly Motor Vehicle Production *(U. S. and Canada)*

	PASSENGER CARS 1942	PASSENGER CARS 1941	TRUCKS 1942	TRUCKS 1941	TOTAL MOTOR VEHICLES 1942	TOTAL MOTOR VEHICLES 1941
January	152,107	423,223	107,905	100,850	260,012	524 073
February	56,189	405,160	98,126	104,172	154,315	509,332
March	9,408	422,289	105,290	111,589	114,698	533,878
3 Months	217,704	1,250,672	311,321	316,611	529,025	1,567,283
April	.....	387,070	.....	102,786	.....	489,856
May	.....	427,538	.....	117,817	.....	545,855
June	.....	427,521	.....	118,757	.....	546,278
July	.....	347,597	.....	121,300	.....	468,897
August	.....	81,689	.....	83,104	.....	164,793
September	.....	170,338	.....	78,413	.....	248,751
October	.....	301,203	.....	100,166	.....	401,369
November	.....	263,104	.....	110,788	.....	373,892
December	.....	181,613	.....	120,905	.....	302,518
Total	.....	3,838,345	.....	1,270,647	.....	5,108,992

MEN . . . . . .

Claude N. Monson has been elected a vice-president of Northrop Aircraft, Inc. He will also continue as treasurer.

Donald M. Palmer and **Stephen F. Hinchcliffe** were elected to the Board of Doak Aircraft Co., and Nelson E. Grace, factory manager, was elected vice-president.

J. E. Hughes has been appointed to the engineering service staff of Adel Precision Products Corp.

Richard C. Long, formerly associated with Wheels Inc., has joined the Warner Electric Brake Co. as New York representative with offices in the General Motors Building.

Edwin J. Schwanhausser, vice-president of Worthington Pump & Machinery Corp., has been elected to the Board of Directors, filling a vacancy created by the death of Edward T. Fishwick. **Charles Neal Barney** was elected a vice-president.

C. Lothrop Ritchie was elected a director of The Brill Corp.

Harkness W. Cram has been elected vice-president in charge of sales of the Aircraft Screw Products Co., Inc.

E. W. Jackson has been named assistant to the president of Caterpillar Tractor Co. D. O. Nash succeeds Mr. Jackson as general service manager.

A. L. Kress has joined Republic Aviation Corp. as assistant to the president.

Charles Owens Guernsey, vice-president of The J. G. Brill Co., has been granted a leave of absence by the company to accept a position as Technical Advisor to Col. D. N. Hauseman, Deputy District Chief of the Philadelphia Ordnance District.

(*Please turn to page* 60)

PUBLICATIONS

Induction Heating Corp. is publishing a series of data sheets to be issued monthly, beginning with April, covering the subject of **induction heating.***

Two leaflets, issued by Detroit Rex Products Co., describe 1, **Spray booth cleaning compounds,** for use in booths where oil-base paints and enamels are sprayed, and 2, methods used in solving **industrial metal cleaning** problems.*

Air Reduction has prepared a 16-page booklet, **Airco In Aviation,** which reviews the several oxyacetylene flame and electric arc processes which are particularly helpful in accelerating the tempo of aviation production.*

Vascoloy-Ramet issued a new bulletin giving complete information, including specifications, of the full range of sizes of **tungsten electrodes** for atomic hydrogen welding.*

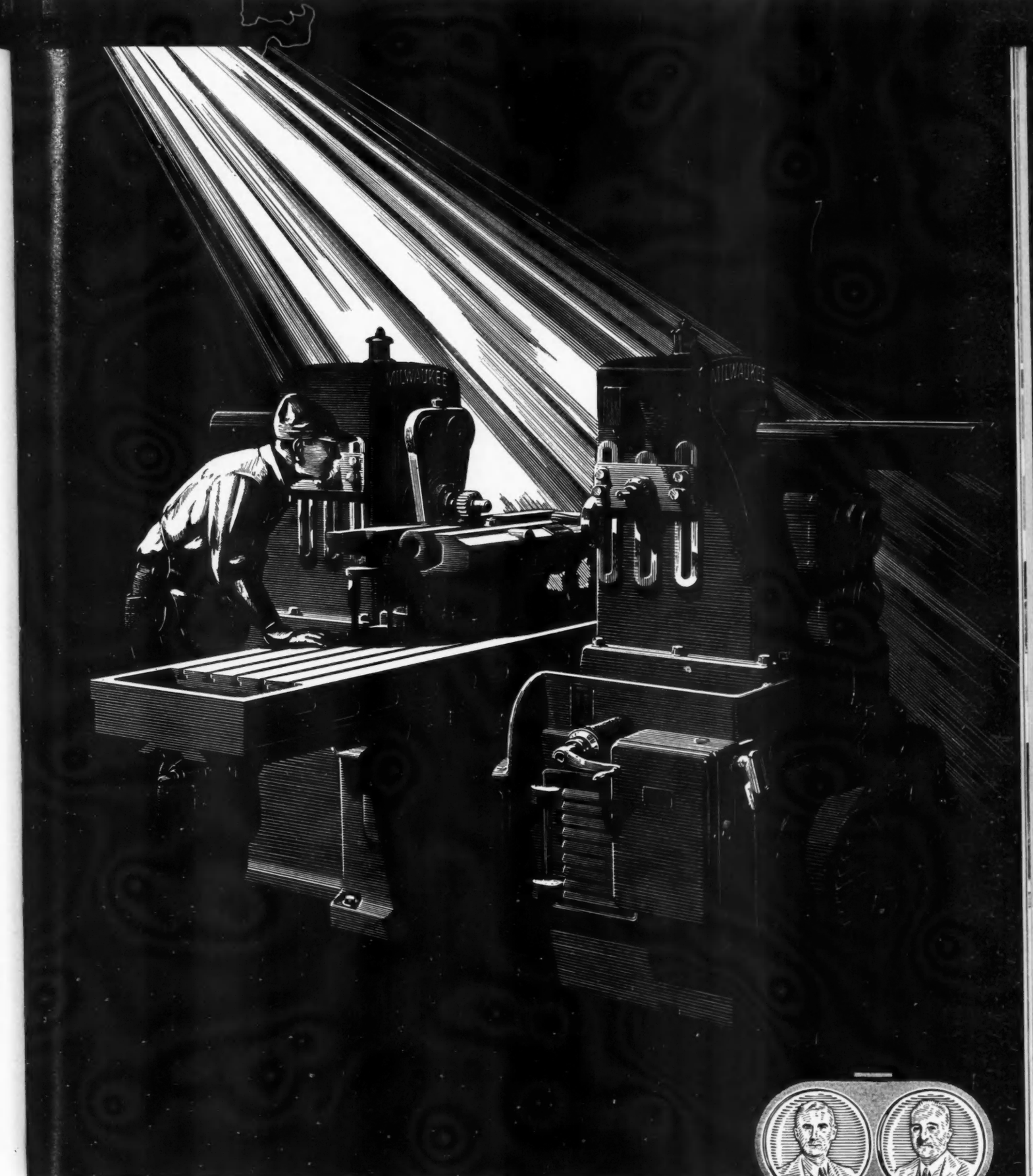
Herman J. Sticht Co. has issued a new bulletin, No. 760, describing its **Model J hand tachometer,** a triple-range instrument, designed to show instantaneously and continuously the speed or change in speed of any revolving shaft or surface.*

The current issue of Repaint Reporter, published monthly by Ditzler Color Co., contains a short article on **how to make finishes adhere to new sheet metal.***

The Hydraulic Press Mfg. Co., has issued a booklet, Hydro-Power (Bulletin No. 411) on **radial pressure generators** and booklet No. 32 describing and illustrating **HPM triple-action presses and HPM triple-action fastraverse presses.***

Engineers' Council for Professional Development has issued a reprint of an address delivered before The Engineering Institute of Canada, Hamilton, Ontario, Feb. 7, 1941,

(*Continued on page* 76)



An application which emphasizes the extreme flexibility of the Milwaukee Duplex Milling Machine.

KEARNEY & TRECKER
CORPORATION
Milwaukee
MILLING MACHINES

Every cut counts on the production line . . . in bringing Victory on the firing line.

KEARNEY & TRECKER CORP., MILWAUKEE, WIS., U. S. A.

Milwaukee MILLING MACHINES

CENSORED

An exclusive feature prepared by the London correspondent of AUTOMOTIVE AND AVIATION INDUSTRIES, M. W. Bourdon.

The Minister of War Transport has announced that he will release 700 of the International truck chassis imported by the Government under the Lease-Lend Act. Would-be buyers must acquire licences to purchase from Regional Transport Commissioners, and the International Harvester Co. in London will handle all transactions and pass them through recognised trade channels. About 100 six- to seven-ton truck chassis and 100 tractor and semi-trailer outfits are immediately available, while 300 of the former and 200 of the latter are now being fitted with various types of bodywork. Chassis prices are £710 for a truck chassis and £1275 for the semi-trailer outfit.

* * *

Out of the gross receipts of Transport Services, a big truck operating company, 21 per cent is absorbed by taxes, said H. C. Drayton, chairman of the company at the annual meeting. The taxes referred to are those attached to the vehicles and their fuel, income tax and excess profits tax. (The latter takes all profits over and above those of the standard pre-war year.) "We are running our trucks flat out," said Drayton, and addded, "Maybe we are over-running them to serve the national interest. The company would certainly have been better off, both now and after the war, if we were running them at 50 per cent capacity, owing to the lower rate of depreciation this would imply."

* * *

Under an amendment of the Essential Work regulations it is now an offence for workpeople in plants directly or indirectly concerned with the production of munitions to be absent from work or persistently late without valid reason. As previously, the regulations also forbid an employee from changing his place of work and prohibit an employer from discharging an employee, without the consent of a National Service Officer, who must take all the circumstances of each case into account.

* * *

It is feared that when, after the end of June, there will no longer be a basic gasoline ration for passenger cars, the public passenger transport services will be overwhelmed, especially the bus services in both town and country, which for long past have been unable to cope fully with the demand for passenger transport owing to fuel restriction, labor shortage, and the lack of new vehicles.

Many of those owners of passenger cars who, anticipating further restriction of the gasoline ration, have had their cars equipped with gas producer plants, will not benefit by their foresight when the basic gasoline ration is discontinued at midsummer, for it has been announced that no fuel will be granted for producer plants, except where the vehicle is used for transport essential to the war effort.

* * *

Tire rationing has been introduced after a ban on new tire sales for four months. It is a complicated scheme involving the restriction of tire sales to a mere 1200 appointed dealers out of over 25,000 hitherto handling tires. Appointed dealers must not supply a replacement except under official authority, and not even thus unless they are convinced that a replacement is essential; except in an emergency they must not supply vehicle owners who have not previously registered with them; vehicle owners must accept any make of tire (either new, retreaded or partly worn) and no owner not holding "Essential" fuel ration coupons may be supplied.

* * *

Owing to the increasing shortage of paper it was suggested in Parliament that there should be either prohibition or restriction of advertisements in newspapers and technical journals. In a recent issue of "The Engineer," it was pointed out, there were 62 pages of advertisements and only 21 pages of reading matter. The suggestion was not accepted by the president of the Board of Trade; moreover, he agreed with Two Members of Parliament who said that advertisements in technical journals, such as that mentioned, often contained most valuable information for engineers—sometimes more valuable to the reader than the editorial matter.

ADVERTISING

J. Herbert Devins, formerly public relations director for J. Stirling Getchell, Inc., in the Detroit office, has been appointed director of public relations for the Bendix Aviation Corp., with offices in Detroit. **H. L. Sharlock** will continue as director of advertising with offices in South Bend.

A. Roy Barbier, formerly advertising manager of the Ford Motor Co., has joined Addison Vars, Inc., Buffalo advertising agency, as an account executive.

Hugh H. Johnson, formerly assistant advertising manager for Buick, has been appointed advertising manager of Bell Aircraft Corp.

The corporate name of **Lang, Fisher and Kirk, Inc.** of Cleveland, Ohio, has been changed to **Lang, Fisher & Stashower, Inc.**

Blaine G. Wiley, All-Steel-Equip. Co., Aurora, Ill., and **Harold Quinlan,** Spencer W. Curtiss, Inc., Indianapolis, Ind., have been elected chapter representatives on the Board of Directors of the National Industrial Advertisers Assn.

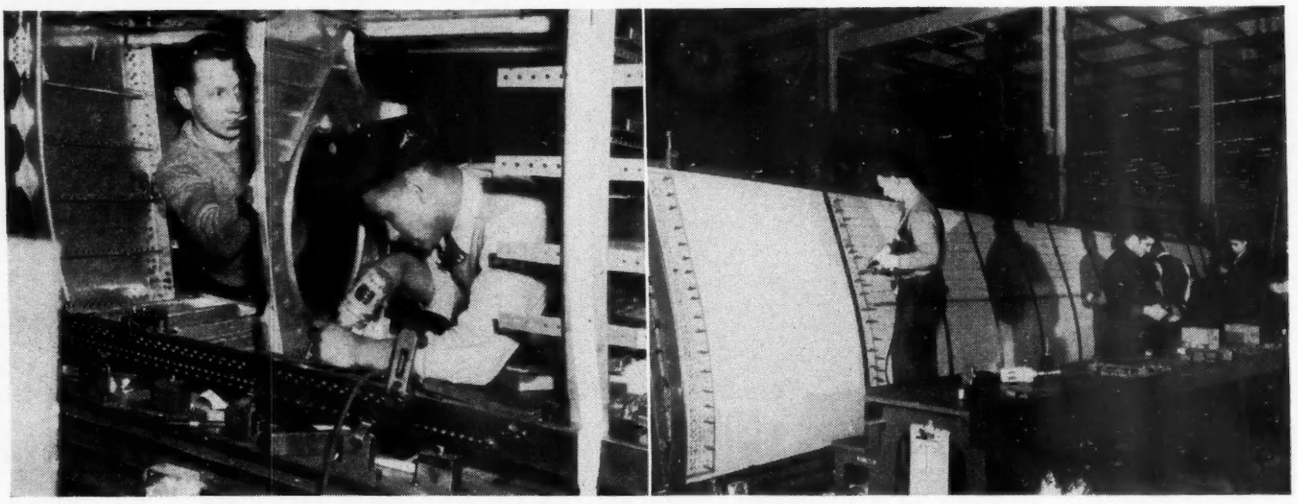
40 YEARS AGO

After wrestling with an automobile three years, I am now at the point where I should hang out big flags and set off colored fires if I could make a 100-mile run with either of my machines without a stop. In fact I think I do well if I go 25 miles and avoid work on the machine . . .

Of course there are few occasions when the owner of an automobile wants to go 100 miles at a stretch, and it isn't often that a 25-mile trip is necessary . . .

The question I am now trying to settle is, when shall I reach the point where I can feel assured that I have skill enough to keep an automobile running continuously? Experience has shown me that if the machines are in perfect order they will run all right. If three years' study has not taught me the necessary knowledge, I am wondering what hope the future holds. Maybe automobiles will be made better, but even with perfect construction a machine requires intelligent and possibly constant attention to keep it in condition for the best work. Therefore, I think any automobile that will run 100 miles without stopping is a good thing.

From *The Horseless Age*, May 14, 1902.



Ford Begins Manufacture of Bomber Parts

Several interesting close-ups of operations at the Ford bomber plant show workmen (left) riveting the center bulkhead to the spar in one of the many large fixtures used in assembly. At the right, workers are fastening the skin to the top side of an outer wing section. Soon these parts will be used in the assembly of B-24 medium bombers.

NINE VOLUMES OF IMAGINEERING

THESE NINE BOOKS are designed to help all men, everywhere, do the Imagineering that improves methods of production and speeds delivery to our fighting men of all war materiel made of aluminum.

HERE AT ALCOA, Imagineering has enabled us to double production and to be well on the way to tripling it, in an amazingly short time. And still the expansion goes on. Swinging immense new plants into top volume at top speed;

building again, and manning that new capacity efficiently . . . This is Imagineering at work for the war.

WE'RE BREAKING RECORDS by sheer determination backed by know-how.

YOU'RE DOING THE SAME. Perhaps your men, many of them new to the ways of working with aluminum, can help you get even more speed through the know-how these books contain.

IN THE DAYS when we made only a driblet of Alcoa Aluminum Alloys, compared to the great flood we are now pouring into the war effort, our engineers could counsel with you personally on fabricating procedures. Today many of these men have been brought back to our plants to join the drive for production. From these books you can get much of the know-how our men used to bring you personally.

OUT OF THESE PAGES, too, will come the exciting Imagineering of the future. Many of the products you will create to meet the new competition, *as well as* millions of jobs for our boys as they come home, will stem from that Imagineering.

Aluminum Company of America, 2110 Gulf Building, Pittsburgh, Pennsylvania.

★ SO MUCH SO SOON ★

ALCOA ALUMINUM

ALCOA

Union Demands

(*Continued from page 47*)

wages be frozen for the duration.

Replying to the union demand for a $1-per-day wage raise and a $100 defense bond as a vacation bonus, Bennett said, "In view of the fact that the Government is the sole customer of the Ford Motor Co. at the present time, any increase in wages would mean an increase in the cost of whatever we are producing for the Government. That would merely increase the cost of our war effort to that extent." Bennett also intimated that the union dues checkoff might be discontinued.

When the Ford contract was signed last June, Ford agreed to meet the wage scale of any competitor in a similar occupation. Bennett not only rejected the $1 a day wage raise, but the 12 other union demands which were drawn up by 127 delegates representing 55 Ford plants who met at Detroit. Demands were similar to those asked of GM with the additional request for appointment of an impartial umpire to settle grievance disputes. The GM contract already provides for such an umpire.

The UAW-AFL resisted an attempt of the UAW-CIO to capture one of the few remaining GM plants in which it holds bargaining rights when it won an NLRB election at the New Departure plant in Meriden, Conn., 2534 to 2024. The UAW-AFL also holds bargaining rights at the Delco-Remy plant in Kokomo, Ind., and the Fisher Body Kansas City Division.

Another UAW-CIO setback was suffered at Cleveland, where employes at two plants of Thompson Products, Inc., voted for independent unions in preference to the UAW-CIO. Only 2491 of the 8224 eligible employes, or 30 per cent, voted for the UAW-CIO. At the new aircraft plant, the independent union won by 2249 to 1203.

The Eaton Mfg. Co. recently signed a union shop agreement with the UAW-CIO covering 4500 employes in four plants at Detroit, Battle Creek and Marshall, Mich., and Cleveland. All employes must continue union members in good standing and probationary employes must joint at the end of their probationary period. Each male worker with more than one year's seniority as of May 31 will receive $75 vacation pay and each female worker with similar seniority will receive $55. Those with seniority between six months and a year will get $25. Double time will be paid after the tenth hour of work in a single day, after eight hours' work on a sixth consecutive working day and for the entire seventh consecutive working day. The Ex-Cell-O Corp., Detroit, recently granted a 10-cent-per-hour wage raise to its 6000 workers, and the Frost Gear Division of Clark Equipment Co., at Jackson, Mich., gave a five-cent hourly boost.

Approximately 54 per cent of the 78,124 eligible voters in Ford Local 600, largest union local in the world, went to the polls recently to elect officers of the local. Chief plums were the presidency, paying $5,000 per year, and the vice-presidency and financial and recording secretary, each paying $4,500. Only one candidate, Shelton Tappes, a Negro foundry worker, received the necessary majority in the large field of candidates and won the $4,500 recording secretary's post. Patrick F. Rice, a Ford electrician for 19 years, and Paul Ste. Marie, a tool and die maker at the Ford plant for 15 years, were one-two among the seven presidential candidates and will engage in a run-off election for the office, along with the two highest vote getters for the other offices.

D. R. Paul Joins OPA

D. R. Paul, formerly connected with the truck department of the Chevrolet Motor Division, has been appointed by the Office of Price Administration to head the field management and liaison section of its Passenger Automobile Rationing Branch.

BROACHING ADVANCES CONTINUOUSLY

BROACHING, which has taken its place among machining methods as a process of great resource, is making continuous advances under the lash of war demand.

New methods of using broaching—new problems solved by it—greater speed—more economy—advances along these lines are of almost daily occurrence.

The Red Ring Double Jump Broach opens an entirely new field of operation, making notable savings in time and tool cost. Red Ring Broaching of multiple involute splines for universal joints and other machine elements permits high strength-weight ratio, and operation with minimum back-lash.

Naloy steel and improved design have provided broaches of amazing ability to stand long runs with a minimum number of regrindings.

When you consider machining methods, consider broaching—and—get the latest information on broaching.

National Broach and Machine Company has pioneered much of the high production broaching. We have accumulated engineering experience that will be valuable to you. We'll be glad to consult.

NATIONAL BROACH AND MACHINE CO.

RED RING PRODUCTS

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SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

MEN

(*Continued from page 54*)

Fred S. Doran has been elected vice-president of Joseph T. Ryerson & Son, Inc.

Edward F. Fisher, vice-president of GM and general manager of the Fisher Body Division, has been elected to the board of directors of General Motors Corp.

John J. Carter, for 10 years general manager of the Olds Motor Works, has joined the Automotive Branch of the War Production Board as supervisor of production engineering.

S. Paul Johnston, formerly co-ordinator of research for the National Advisory Committee for Aeronautics, has been named manager of the Washington office of the Curtiss-Wright Corp.

Louis W. Petersen, formerly assistant general traffic manager for Nash-Kelvinator Corp., has been appointed general traffic manager of the implement and tank divisions of the Massey-Harris Co.

F. H. Janke, formerly treasurer, has been elected assistant to the president of American Brake Shoe & Foundry Co. **Kempton Dunn** has been elected treasurer to succeed Janke.

B. H. Sweeney, formerly resident manager of the Fisher Body St. Louis Division, has been appointed manager of the new tank plant at Grand Blanc, Mich. **Don R. Larkin,** formerly assistant manager, has been advanced to the post of resident manager of the Fisher Body Pontiac Division, succeeding **E. R. Leeder,** who now heads the Artillery Carriage Section of Fisher Body's war activities.

R. E. Stone, vice-president, and **A. W. Massnick,** general counsel, have been elected to the board of directors of Graham-Paige Motors Corp.

John P. Coe, formerly general manager of the Naugatuck Chemical Division of U. S. Rubber Co., has been appointed head of the newly created synthetic rubber division.

Edward B. Whitman, formerly in charge of terminals for the Merchants and Miners Transportation Co., has been appointed public relations director for the American Hammered Piston Ring Division of the Koppers Co.

Joseph L. Overlock, at one time treasurer and assistant to the president of the Studebaker Corp., has been appointed Chicago regional director of the War Production Board.

Martin C. Callahan, of Detroit, and **Howard J. Stoddard,** of Lansing, have been elected to the board of directors of Bohn Aluminum & Brass Corp.

G. A. Shallberg, general counsel and vice-president, has been appointed executive vice-president of Borg-Warner Corp.

Charles E. Wilson, president of General Motors, and **Herbert J. Woodall,** president of Woodall Industries, Inc., have been elected directors of the Detroit Board of Commerce. Reelected a director was A. M. Wibel, vice-president of Ford Motor Co.

Hubert G. Larson, formerly eastern investment manager of Motors Holding Division of General Motors, has been named an assistant chief of the Automobile Rationing Division of OPA. **Robert E. Stone,** on leave of absence from University of California, also has been appointed an assistant chief in charge of appeals from decisions of local rationing boards. **Dr. Harry R. DeSilva,** formerly a research associate at Yale University, has been named head of the division's research and quotas unit.

D. M. Miller, vice-president and operations manager, has been placed in charge of the new Des Moines, Ia., plant of Solar Aircraft Co. **Earl D. Foster** will become operations manager at the San Diego plant, succeeding Miller. **A. J. Biddle,** formerly purchasing agent, will become materials division manager at San Diego.

C. E. Spain has been appointed a vice-president of Caterpillar Tractor Co. **C. O. G. Miller,** board chairman of Pacific Lighting Corp., has been elected a member of the board.

Charles M. Schoenlaub has been appointed acting chief of the Production Requirements Branch of WPB.

The following have been elected vice-presidents of Westinghouse Electric & Mfg. Co.: **Andrew H. Phelps** of Pittsburgh, Pa., manager of purchases and traffic; **L. E. Osborne** of Philadelphia, Pa., manager of the steam division; **Frank C. Reed,** of Jersey City, N. J., president of Westinghouse Electric Elevator Co., a subsidiary; **Walter C. Evans** of Baltimore, Md., general manager of radio, X-ray and broadcasting divisions. They will all continue in their present executive posts.

Karl R. Kopanka has been appointed manufacturing manager of Sealed Power Corp.

Frank U. Hayes has been appointed assistant sales manager of The Bullard Co.

Charles M. Craighead, formerly with the Aluminum Co. of America, has been named a research metallurgist at Battelle Memorial Institute, Columbus, Ohio.

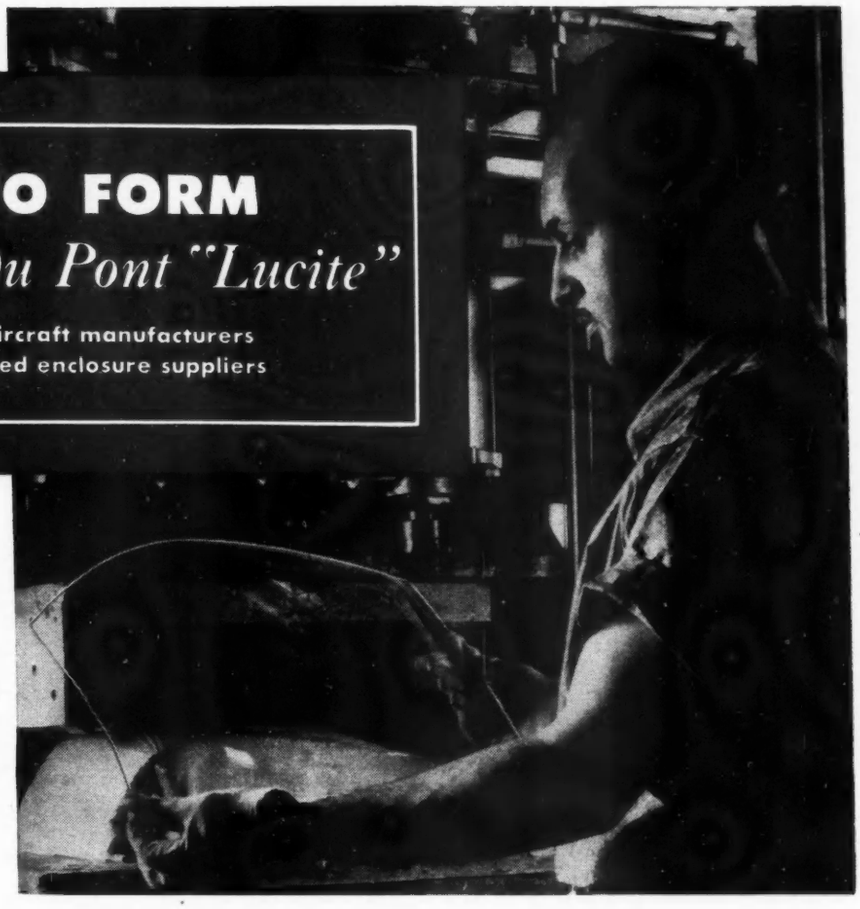
Guy T. Avery, work manager of the Riverdale, Ill., plant, and W. Sheridan Huss, sales manager of the central district, were elected members of the Board of Directors of Acme Steel Co.

A. F. Boucher, district manager of the Detroit office of The Lincoln Electric Co., has been called to active duty. He will be attached with the Ordance Dept. **C. H. Buckmaster** of the Pittsburgh office will assume Boucher's former duties and **J. H. Cunningham** of the Detroit office will take over Buckmaster's duties at Pittsburgh.

Arthur Linz has been appointed vice-president in charge of the conversion plant at Langeloth, Pa., of the Climax Molybdenum Co., succeeding Alan Kissock who has resigned. Mr. Linz will also continue to direct the activities of the company in the chemical field.

HOW TO FORM
transparent Du Pont "Lucite"

Information for aircraft manufacturers and their established enclosure suppliers



PART 2: ***Simple and deep-draw techniques for forming acrylic sheeting for aircraft enclosures***

HEATING is the first step in forming transparent "Lucite" methyl methacrylate sheeting. Temperatures of from 221°F. (105°C.) to 284°F. (140°C.) make the sheets pliant for easy forming. A hot air oven, with suitable temperature controls, is generally the best equipment for this purpose.

SIMPLE FORMING

To shape small formed pieces with only a slight amount of curvature, simple forming blocks may be used. The hot acrylic sheet is draped over this form by hand. It is then pressed down with the fingers to assume the block's shape. Clean cotton gloves should be used to prevent fingermarks.

The blocks may be made of plywood, metal, plaster, or any other rigid material which will keep its contour and dimensions at the moderate temperature and pressure used in forming. The form may be made to the same dimensions as the formed piece or slightly larger. The latter adds to convenience in handling. Cutouts may be made in the block for ribs or other appendages to the sheets.

The surface of the forming block must be smooth and free from blemishes of any kind. It is sometimes advisable to cover the surface with a soft cloth (such as chamois cloth), soft felt, or suede rubber sheet.

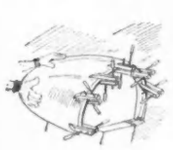
Trim lines may be scored on the block to aid in establishing the exact shape of the formed piece. Unless the block itself is dimensionally true and the edges are to be used to determine the shape of the piece, trim lines or guide marks of some kind will be found necessary for accurate work. Allowance should be made for the slight contraction of "Lucite" upon cooling from its softening temperature.

The sheet may be held in place by means of padded metal strips around the edges. One of the best methods is to stretch heavy rubber bands across the edges of the sheet and attach them to hooks or nails on the base of the block. The piece may also be held against the block by means of a simple yoke and press.

When the "Lucite" is thoroughly cooled it may be removed from the block. Cooling will require 10 to 15 minutes for a 0.250″ caliper piece, as a general rule. No measurements should be taken or scribe marks made on the "Lucite" piece until it has reached room temperature.

DEEP-DRAW FORMING

Where compound curves exist, it becomes necessary to use more drastic forming conditions. The sheeting must be raised to a higher temperature to render it more pliable and then it must be forced over the form and held firmly in place until cool.



Depending on the nature of the shape desired, the forming may be done by hand, or male and female dies may be used. If sharp curves or peaks are to be produced, male and female forms will be necessary.

This type of forming requires particular skill and demands more experience than ordinary stretch-forming. The female form may be simply a frame, and this reduces the danger of obtaining "diemarks." A hydraulic press may be used if adequate care is taken and a minimum pressure is applied.

The male die is coated with rubber suede sheeting—the female also, if a complete form is used—and the hot "Lucite" sheet is draped into the female. The male die is then lowered and the sheet is pressed into shape.

To conserve heat in the die, sheets are pressed in series. A scrap sheet may be used to pre-heat the die before the series is started.

Du Pont will be glad to render technical assistance to aircraft manufacturers and established fabricators of "Lucite" serving the airplane industry, on questions of forming, machining, mounting or designing of transparent enclosures. E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, N. J.; and 5801 So. Broadway, Los Angeles; 350 Fifth Avenue, New York City; 1808 No. American Bldg., Chicago: General Motors Bldg., Detroit.

DU PONT

REG. U. S. PAT. OFF.

LUCITE

REG. U. S. PAT. OFF.

METHYL METHACRYLATE RESIN

Plant Conversion

(*Continued from page* 46)

struction of the bombers. As an example, one wing section required 99 man-hours of labor under the old method. Spot welds were substituted for rivets and the time was cut to 64 man-hours, effecting a 35 per cent time saving. Ground was broken for the Willow Run plant April 18, 1941. By Sept. 1 the first machinery had arrived for installation and in early October manufacture of parts began.

Production also is progressing on Martin B-26 bomber subassemblies at Chrysler and Hudson plants. These will be shipped to a Midwest plant for final assembly. Chrysler's bomber fuselage manufacturing is proceeding rapidly with two assembly lines already in operation and more being filled. The medium bomber which these companies will build contains 32 major assemblies and 30,000 parts, exclusive of the engines, nut, bolts and rivets.

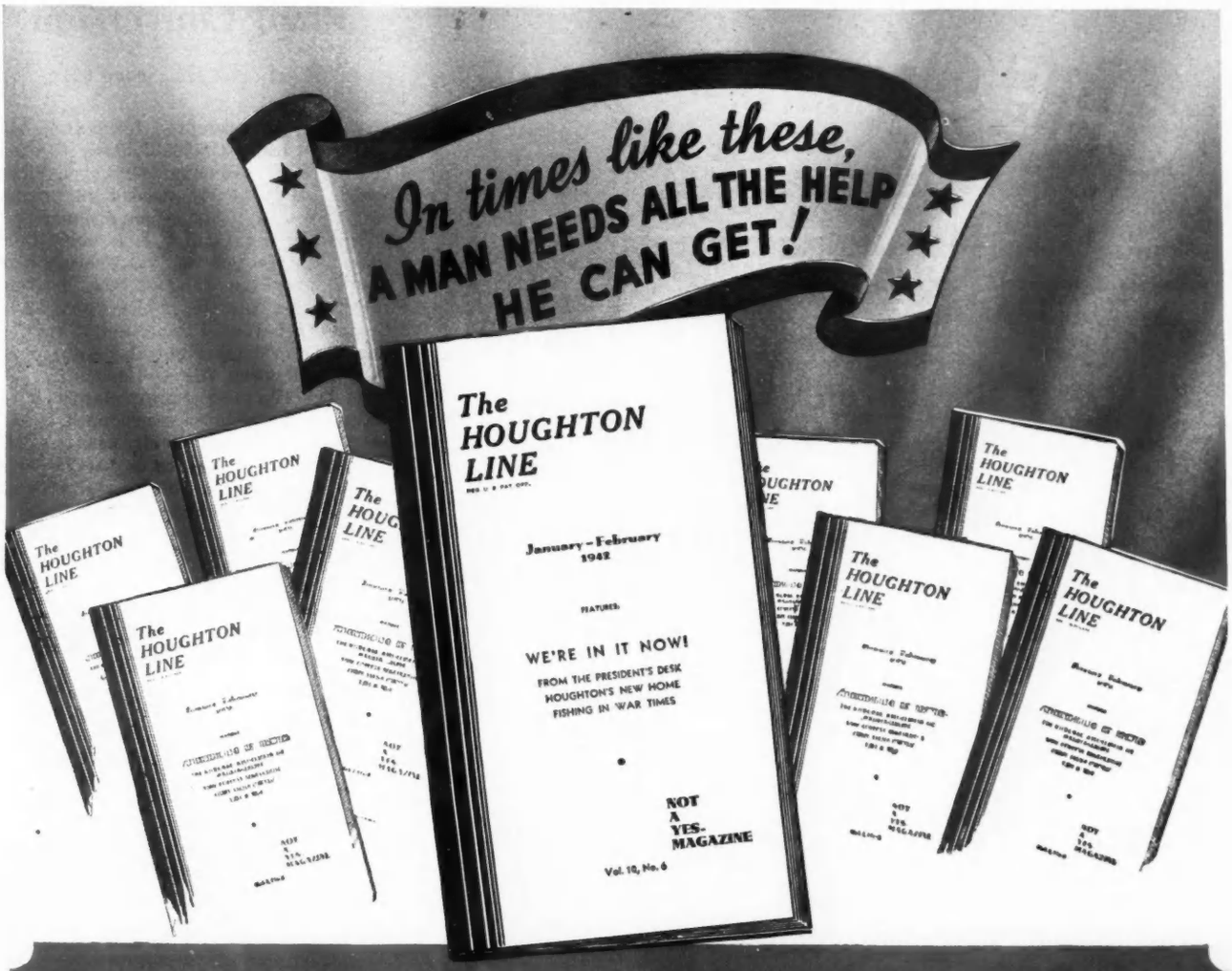
Briggs Mfg. Co. and Murray Corp. of America, two of the largest body builders in the automotive industry, also were represented on the Automotive Committee for Air Defense and are now playing an important part supplying the aircraft companies with airframe subassemblies. Briggs is making five types of aircraft subassemblies for Boeing, Douglas and Vought-Sikorsky. Seventy-five different duct sections are being turned out for Flying Fortresses, as well as wings, ailerons, stabilizers, fins, rudder and tail assemblies, bomb bay doors and bomber turrets for various aircraft types. Murray Corp. is shipping wing sections, engine nacelles and other parts to Boeing and Douglas. Both Briggs and Murray employ former automobile body building techniques in adapting welding practices to airframe fabrication.

Chrysler's bomber fuselage production is only one of 24 major war projects which the corporation has undertaken. The production of medium tanks was four months ahead of schedule Jan. 1 and in the first four months of 1942 output has been twice as great as in all of 1941. Chrysler is preparing to change over from the riveted M-3 medium tank to the all-welded M-4 model without anticipating any interruption to production. This change will make obsolete huge cold-riveting machines developing 100 tons pressure that have been used to fabricate armor plate on the M-3. These machines probably will be sold to shipyards for riveting there.

Chrysler's production of 40-mm. anti-aircraft guns also has been stepped up at a fast rate since Pearl Harbor. In each of three successive months the output of these guns was tripled and in April it was 39 per cent ahead of Government promises. By July 1 it is expected that anti-aircraft gun production will be doubled again if material and machine shortages do not interfere. In adapting the foreign-designed gun to mass production, a Chrysler engineer suggested one change that has effected a saving of 30 lb. of critical material on each gun and eliminated the necessity of buying six machine tools needed elsewhere. An engineering change on another part of the gun saved 11 lb. of aluminum and 20 lb. of lead per gun.

Indicating the completeness of the conversion job in Chrysler's 19 U. S. plants, more than 78 per cent of all the corporation's machinery is being used or being prepared for use on war work. Inter-plant shifting of machinery has been great. Recently three large machines from the Plymouth plant, used on automotive cylinder blocks, were moved across Detroit to the Chrysler-Jefferson plant to machine crankcases for tank engines. Chrysler is adapting automotive engines to power the M-4 tank. Three drills used to make steering knuckles for passenger cars were shipped from the New Castle, Ind., plant to the Dodge plant in Detroit for use on tank engines. In return the New Castle plant received 20 screw machines from Dodge, formerly used on automobile parts, to make shell cores. Three rotary milling machines formerly devoted to motor vehicle produc-

(*Please turn to page* 64)



CAN *YOU* USE AN EXTRA 77 YEARS OF EXPERIENCE?

As industry changes over from peace-time to war production, plant men face many new problems — machining new steels or new metals . . . cleaning, heat treating, quenching, preventing rust, special lubrication. These problems are covered regularly in the "Houghton Line," which for 34 years has been sent to industrial plant executives the world over.

We believe we can contribute materially in the present emergency, not only with products and service along these lines, but also by increasing the circulation of the LINE to cover more men who have been stepped up to new and unfamiliar responsibilities. If you do not now receive the LINE and would like to enjoy its frank business comment as well as its practical processing articles, sign and mail the coupon below.

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Gentlemen: Please enroll me to receive the "Houghton Line" regularly without charge or obligation.

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Firm _____
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City _____ State _____

A1

Plant Conversion

(*Continued from page* 62)

tion have been adapted for a tank engine operation, thus obviating the necessity for ordering new machines which are urgently needed for many war uses. Another war product required the machining of a shaft four times the length of an average-size shaft. Working through the Tooling Information Service of the Automotive Council for War Production, Chrysler finally located the right size equipment at the Michigan Alkali Co.

At the Chrysler Forge plant where aluminum forgings are produced, a 25-year-old bar mill is being used to roll down bars of aluminum to size for aircraft parts. Before the gear shift was switched to the steering column, this machine was used to make gearshift levers for Chrysler cars by passing bars of hot steel through the rolls, working them down to shape and size. When the old floorboard gearshift column became obsolete, this bar mill was shipped to the corporation's machine "graveyard." But with the opening of the aluminum forge plant, some engineer with a good memory thought of the old bar mill as a time saver. It was resurrected, new sets of rolls were built and now it serves an essential war role by reducing aluminum bar stock to smaller size so it can be placed in the forging hammers for shaping.

On April 25, just a year from the date that the first letter of intent was received from the Government, Oldsmobile had completed shipments on its original contract for aircraft machine guns. The first completed guns came off a pilot line last fall and by January production was at the maximum rate scheduled under the original contract.

Although many of the war production jobs which the automotive industry has undertaken are already tooled up, some tooling is still going forward. The Tooling Information Service of the Automotive Council for War Production is playing an important part in this field, providing data on available tool room capacity and locating jigs and fixtures. A Michigan plant engaged in work on a 20-mm. projectile recently placed orders for 287 different jigs, fixtures and gages through the service. Another firm seeking idle capacity on jib borers located five plants which agreed to share this work. The Tooling Information Service made 50 inquiries before the idle shop capacity was found. A company at Jackson, Mich., working on a tank order needed turning equipment for a wheel 78 in. in diameter. This was finally located at a railroad shop in the same city. The industry invaded the quarry field to uncover a huge planer needed to machine large metal plates for experimental aircraft work. The planer was located in Bedford, Ind., where it had been used to cut 15,000-lb. blocks of limestone.

These Metals Gain Strength at

SUB-ZERO TEMPERATURES

...yet do not become Brittle!

MECHANICAL PROPERTIES AT LOW TEMPERATURES

MATERIAL	Condition	Temperature °F.	Yield Strength (0.20% offset) psi.	Tensile Strength psi.	Elongation in 2 in. per cent	Reduction of Area per cent	Hardness Rockwell C	Charpy Impact Strength ft.-lb.
MONEL	Cold-drawn	Room	93,700	103,800	19.0	71.0	19	181
	Cold-drawn	—110	100,850	117,450	21.8	70.2	25	178
"K" MONEL	Cold-drawn age-hardened	Room	125,900	157,300	15.5	37.4	33	27
	Cold-drawn age-hardened	—110	134,600	171,550	17.3	41.1	36	27
INCONEL	Annealed	Room	36,800	93,800	37.3	64.1	82B	130
	Annealed	—110	42,400	106,450	39.8	64.0	87B	134
	Cold-drawn†	Room	147,700	152,100	7.0	49.3	31	54
	Cold-drawn†	—110	154,900	163,900	9.8	51.2	36	60
NICKEL	Cold-drawn	Room	97,400	103,400	16.3	66.9	19	204
	Cold-drawn	—110	101,800	112,300	21.5	60.9	22	215

† 50 per cent reduction in cross-sectional area by cold drawing.

plus **CORROSION RESISTANCE** . . . together with strength, hardness, toughness —

plus **EXTRA HARDNESS** . . . comparable to heat-treated alloy steel; age hardenable, non-magnetic —

plus **HEAT RESISTANCE** . . . with retention of high degree of strength. Resists oxidation, high corrosion resistance—

plus **NON-CONTAMINATION** . . . protects product purity; offers good electrical conductivity —

plus **MACHINABILITY** *and* **EXTRA HARDNESS** . . . free cutting, age hardenable, non-magnetic —

plus **RESILIENCE** . . . age hardenable, for exceptional spring properties, magnetic, good electrical conductivity —

plus **MACHINABILITY** . . . for high speed production in automatic screw machines —

plus **HARDNESS** *in* **CASTINGS** . . . anti-seizing and non-galling—

"KR" MONEL

"Z" NICKEL

"R" MONEL

"S" MONEL

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At sub-zero temperatures, for example, most ferrous metals become brittle as their strength increases. INCO Nickel Alloys also increase in strength and hardness . . . but they retain room-temperature ductility and toughness as measured by tensile and impact tests (*see table above*).

Two INCO Nickel Alloys, "K" Monel and "KR" Monel retain another important property, non-magnetism . . . magnetic transformation point of these age-hardened alloys being —150° F.

A new technical insert, "Mechanical Properties at Low Temperatures" and the booklet "Individualized INCO Nickel Alloys" offer useful information. For copies of each write to:

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N.Y.

FIRST THINGS FIRST

With the Nation at war, supplies of Monel, Nickel and Nickel Alloys are needed for our armed forces. All efforts must now be aimed toward victory. In the meantime The International Nickel Company will continue to issue information which it is believed will be of interest to metal users who are concerned with the war needs of today and the peace-time progress of the future.

★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • NICKEL • "Z" NICKEL

Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

Duplicating Templates by the X-Ray Process

(*Continued from page* 45)

prints. Where it is necessary to list specifications and tolerances on the face side of the template, a positive must be made. Originally it was believed necessary to use glass in making negatives for future prints. However, when this was tried, many problems arose. For maximum sized templates, large sections of glass were needed. These were not only difficult to handle, but there was a question as to whether the large quantities needed could always be supplied.

Reverting to the original idea, the surface being used for negatives is first treated with fluorescent lacquer and then the Matte transfer film is placed over this base. When the negative is put under the X-ray, the fluorescent lacquer base activates the template lines. By putting the negative and print surface together in a vacuum press, the finished print is made. It requires approximately 3 to 5 min. in the vacuum form to effect the transfer. Then the print goes through the normal process of photographic development.

The dark-room constructed for this new process of photo-template duplicating is 38 ft. square. On one side is a light-trap joining the lofting department next door. When the loftsman completes the scribing on the template material, he opens the door on the loft side and places the template layout in the trap. By opening a door on the other side, a man receives the layout in the photo-template department, where it starts through the various phases of the duplicating process. Upon completion of the work, the original template is returned through another light trap to the loft department, where it is stored for future use. This template may be used indefinitely in making duplicates. As the duplicate template leaves the wash tanks it is rolled dry and sent to an attached drying room. When the loft department receives the duplicate, they follow the photographed lines to cut out the pattern. It is then ready for use.

Six tanks are used in the photo set-up. Five of these measure 6 in. by 10 ft. by 5 ft. deep, and are used for developing solution, stop-bath, and fixation solution. The sixth tank is a large wash tank 14 in. by 10 ft. by 5 ft. deep.

The low operating expenditure, coupled with the fact that North American equipped its laboratory for around $6,000, makes it possible for the small manufacturer to install the same set-up. It is felt that this entirely new precept in photo-template reproduction will be beneficial to all industries where templates are used, and to many other types of businesses where it can be helpful in making photo murals and in sales promotion work.

British Defiant Night Fighter

(*Continued from page* 19)

below the engine, ahead of the wing.

A point worthy of mention is that, to insure the control column of the cockpit having a constant effective length, it is mounted on the frame of the pilot's seat, while among features embodied in the interests of production is the provision of interchangeable elevators, with the tab-operating rod at the top on one side and at the bottom on the other.

With a turret even so compact as the one on the Defiant, drag is an obvious drawback, but it has been eliminated in this instance to an appreciable extent by the use of "disappearing" fairings forward and aft of the turret. They hinge down to permit the guns to be traversed and are operated by pneumatic "jacks" brought into effect by cams on the turret. The hydraulic operating system of the turret is entirely separate from that of other hydraulic controls.

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FOR AMERICA'S MIGHT

● Speed — essential, of course! Faster and faster we must produce planes, tanks, and all necessary tools of war. Accuracy — still more essential! Without it, speed is waste effort.

Clearing—the way to both! Huge presses stamp out parts for planes and tanks; and do all the forming operations on cartridge cases and other munitions. Huge power presses, Mechanical and Hydraulic — bearing the name "Clearing."

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MECHANICAL AND HYDRAULIC PRESSES

CLEARING
MACHINE CORPORATION
CHICAGO

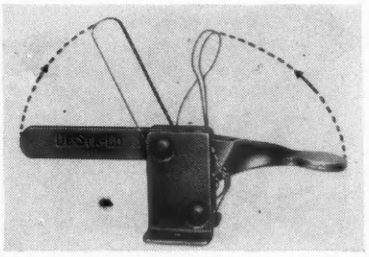
MEN and MACHINES

(*Continued from page 40*)

the printer employs two 40-watt white fluorescent tubes enclosed in clam-sheil shutters which provide positive, infinitely variable light control.

Driven by a ¼-hp, 110-v, variable-speed a-c motor, the printer is supplied with a two-speed gear shift which gives speeds ranging from two inches to three feet per minute in low gear, and from 10 inches to five and one-half feet per minute in high gear. All speeds between these two ranges are achieved by operation of the motor controller. Requiring a table space of 60 by 18 inches, the machine is 22 in. high, 60 in. wide, and 18 in. deep.

A NEWLY designed Mototrace, designated as Type V and built by the Physicists Research Co., Ann Arbor, Mich., is offered to replace Type U which was formerly manufactured. The Mototrace, used to secure accurate readings on very fine surfaces, is also useful for measuring softer materials, awkward shapes, distances as short as 1/32 in., and surfaces such as those in small holes adjacent to shoulders or bosses and on gear and hob teeth. The original cam-and-toggle operating unit has been replaced by a 9-watt driving motor. With this design a length of stroke from 1/32 in. to 3¾ in. can be obtained. In addition to a long available trace, the former dead spot from ⅛ to ⅜ in. is eliminated, thereby allowing continuously adjustable setting.



To meet demands of the aircraft industry for a small size horizontal-type toggle clamp, the Detroit Stamping Co. has added De-Sta-Co. No. 205 toggle clamp to its line. Measuring 1 9/16 in. high by 5⅛ in. from tip of handle to tip of arm, the clamp weighs 3⅛ oz.

A QUICK-ACTION Airlox Senior pneumatic vise designed by Production Devices Incorporated, East Hartford, Conn., for production set-ups features a completely enclosed mechanism consisting of a single-acting piston working through a powerful leverage. With a jaw opening of 7 in. between jaw faces, the vise provides a gripping force of 50 times air line pressure and consumes only 0.02 cu. ft. per operation. A complete line of Schrader accessories is available, including automatic cam or trip valves for synchronized operations, as well as foot or knee valves, couplers, hose assemblies, etc.

TWO new tools designed to speed production in aircraft plants have been recently introduced by Aircraft Tools, Inc., Los Angeles, Calif. The first is a chip chaser for cleaning seams between sheets after holes have been drilled for riveting. This tool has a blade of spring steel and a die cast handle firmly attached to the blade.

The second new tool is a hook scraper for burring sheet stock. It quickly removes burrs and rough edges from sheet stock. Two sizes handle all thicknesses of stock.

THROUGH the use of new alloys, a thermostatic bimetal recently announced by the W. M. Chace Co., Detroit, affords a 40-per-cent saving in weight, and makes it possible to fit a thermostatic element in a smaller

Installing a *PLEXIGLAS* nose

PLEXIGLAS *has seen active military service since 1936. In transparent nose sections, gun turrets, cockpit enclosures, observation domes, side windows, tail assemblies, landing light covers, and antenna housings,* PLEXIGLAS *installations similar to those seen in this picture of the Consolidated B-24 are to be found on every kind of fighting plane built in America.*

TO provide designers and engineers with practical information on proved methods of installing PLEXIGLAS sections in aircraft, Rohm & Haas has just published a PLEXIGLAS *Methods of Installation* manual.

This 48-page booklet not only contains a number of specific suggestions for mounting PLEXIGLAS, but also outlines the considerations behind these designs.

Copies are available to interested aircraft engineers and executives.

THE CRYSTAL-CLEAR ACRYLIC PLASTICS

PLEXIGLAS

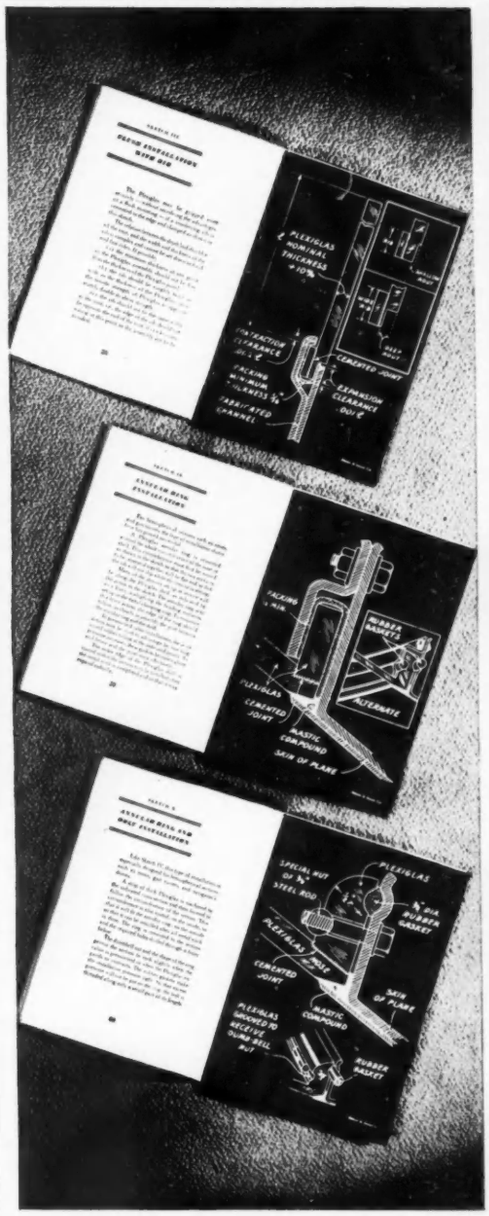
SHEETS AND RODS

★

CRYSTALITE

MOLDING POWDER

PLEXIGLAS and CRYSTALITE are the trade-marks, Reg. U. S. Pat. Off., for the acrylic resin thermoplastics manufactured by the Rohm & Haas Company.



SPECIMEN PAGES

For mounting PLEXIGLAS *sections in aircraft, the new* PLEXIGLAS *Methods of Installation booklet contains full scale sketches similar to the ones shown above. Write for your copy today.*

ROHM & HAAS COMPANY

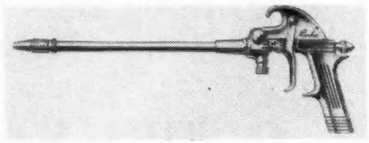
WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Leather and Textile Specialties and Finishes.. Enzymes.. Crystal-Clear Acrylic Plastics.. Synthetic Insecticides.. Fungicides.. and other Industrial Chemicals

space. Especially suited to installation in aircraft controls, the new bimetal is said to have a decidedly increased sensitivity.

EQUIPPED with pistol grip, adjustable material control, adjustable nozzle, and a ¼-in.-standard-pipe-thread air connection, the Binks No. R3-EC cleaning gun uses approximately four cfm of air at 40 to 50 psi. It can be used to pump any kerosene-type cleaning fluid from a quart syphon cup or from an open container.

Other new developments are briefly described in the following paragraphs:



Binks R3-EC cleaning gun.

TCM High Speed Steel

A new tungsten molybdenum steel said to cut as well as or better than 18-4-1, conserves strategic alloys and meets demands for high-speed steels required in the war production effort. Jessop Steel Co., Washington, Pa.

Anti-corrosive Wrappings

New line of papers providing high strength, pliability, and moisture proofness. Riegel Paper Corp., New York City.

New Plastics

Plastics with a wide range of uses as alternates for rubber, copper, tin, aluminum, monel, stainless steel, and other materials. Colonial Alloys Co., Philadelphia, Pa.

Corrosion Preventive

D. P. Solution when added in small amounts to various chemicals prevents corrosion of plain steel drums. Merrimac Div. of the Monsanto Chemical Co., Everett, Mass.

Thin-Slot Insulations

New thin types of Irv-O-Slot provide non-bulking slot insulation for use in limited space. Irvington Varnish & Insulator Co., Irvington, N. J.

Tag Substitutes

New adhesive Kum-Kleen tags offered as substitutes for name plates, metal tags, etc., can be applied without moistening to many surfaces. Avery Adhesives, Los Angeles, Cal.

Weld Spatter Eliminator

Acme Quality Industrial Finish Flash-Off No. 99 painted on metal to be welded eliminates weld spatter. Acme White Lead and Color Works, Detroit, Mich.

Solvent Cups

Du Pont Plastacele cellulose acetate plastic cups when attached to corroded studs hold oxide solvent. Produced by Caldwell Products, Inc., New York, N. Y., for Anti-Rust Corp., New York, N. Y.

Fluorescent Lighting Unit

New diffuser unit designed primarily for use in offices. Curtis Lighting, Inc., Chicago.

Wooden pilot seats produced by the Morrow Aircraft Corp., San Bernardino, Cal., are said to eliminate 80 per cent of the metal currently being used in seats.

ZINC IN WAR

"KEEP" [illegible]thy"

It is rather ironic that zinc is used in the brass for shells that wound men—and in pharmaceuticals that heal them. Such is the futility of wars, yet such is the widespread importance of zinc when wars are thrust upon us. The use of zinc oxide in the preparation of adhesive tape, ointments and other medicinal products is one which carries an unquestioned preference rating. Pharmaceutical (U.S.P.) zinc oxide is the purest type of zinc oxide known and it is characterized by several outstanding qualities. It is protective, mildly astringent and adhesive. The exceptional fineness and whiteness of this zinc oxide make it especially suitable in ointments, dusting powders and adhesive tape.

While most of the war uses, shown in the index of this book, involve larger tonnages of zinc than U.S.P. zinc oxide, few are more important from a utility standpoint. The needs of the Medical Departments of our armed forces are just another reason why civilian users of zinc may not be able to obtain all of the metal or pigment they would like to use.

THE NEW JERSEY ZINC COMPANY

MANUFACTURERS OF THE FAMOUS HORSE HEAD ZINC PRODUCTS

7 PHARMACEUTICALS

METAL SPRAYING

GALVANIZING

NICKEL SILVER

1 HULL PLATES

2 RUBBER

3 PAINT

4 BRASS

5 CERAMICS

6 DIE CASTING

New Jersey zinc

German Warplane Construction

(*Continued from page* 23)

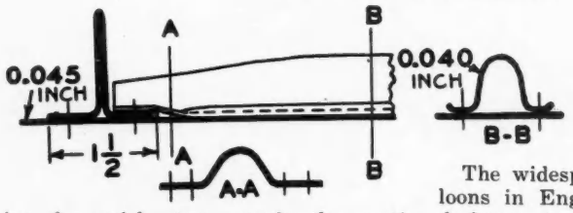


Fig. 9—Dornier fuselage stringer and frame

Courtesy of AIRCRAFT ENGINEERING (England)

ing for quick stops—again the continental provision for getting in and out of very small fields.

The widespread use of barrage balloons in England has forced German designers to change the design of their bomber wings so as to provide balloon cable guards or cutters at the wing tips and leading edges. Both the Heinkel and the Junkers planes have barrage balloon cable fenders taking the form of a streamlined bar running from the nose of the fuselage to the tips of the wings in a wide-angle V. The wing attachments are 4½ ft. and 15 ft. from the wing tip on the Junkers and 12 ft. to 22 ft. on the Heinkel. On the Heinkel flat steel braces flush with the wing surfaces are used and thick steel brackets projecting 1 in. are used on the Junkers. Both ships have wing tip boxes containing cutters.

The Heinkel cabin and the leading edge of the wings are exhaust heated through lagged flexible tubes. The pilot's windshield has a defroster arranged just as in our American motor cars by projecting a fan-shaped stream of warm air against the inside of the glass (plastic in the case of the airplane). Again the crew is protected by two sheets of armor forming angles to each other.

The Heinkel ship is protected by four machine guns, one mounted in the pilot's compartment, one in the tail which is usual as to position but unusual in the fact that the gunner is protected by armor even at the expense of visibility and two guns in the mid-upper portion of the fuselage. Two bomb carriers, each for a 2200-lb. bomb, or large type incendiary bomb carriers are mounted under each wing, but jettisonable tanks can be substituted for these for use in long-distance raids and ten normal bomb carriers are fitted in the fuselage compartment with "belly trap doors" much in the same manner as ours are carried. The B.Z.A.I. dive bombsight is mounted from the roof of the pilot's cockpit and the computor is mounted in the rear fuselage compartment.

PUBLICATIONS

(*Continued from page* 54)

entitled **The Second Mile.** Single copies are 10 cents each and may be had by addressing the council at 29-33 West 39th Street, New York City.

A new guide book for DOALL operators entitled **A Chalk Talk on 40 Different Ways to Cut Machining Costs,** has been issued by Continental Machines, Inc.*

McKenna Metals Co. has issued a 48-page **Kennametal Vest Pocket Manual** containing chapters on selecting, designing, using, brazing, and grinding Kennametal tools.*

Chambersburg Engineering Co.'s new booklet, **Cecostampings,** describes and illustrates a different type of production machinery originated by them specifically for the needs of the aviation industry.*

Mercury Mfg. Co. has issued a new brochure covering its line of **lift trucks** of 6000-lb. capacity. The booklet contains many illustrations and specifications for three types of trucks, low, high, and telescopic.*

New literature by Westinghouse Electric & Mfg. Co. includes a folder describing **variable-voltage planer drives,** for increasing planer production in industrial plants, and a 64-page **Quick Selector Catalog** which simplifies the selection of many types of electrical equipment.*

Metallizing Engineering Co. has just issued a 16-page bulletin, 42-A, describing the metallizing process and equipment for its application.*

GET ENGINEERING DATA

on Oil Seals for Bearings

IF you are responsible for the design of bearings or their application, you should have a copy of "The Perfect Oil Retainer for Modern Bearing Protection and Lubricant Retention," published by the Chicago Rawhide Manufacturing Company. It contains readily usable data on:

- Construction Details of twelve types of Oil Seals.
- Twenty-six typical application drawings for both Plain and Anti-friction Bearings.
- Recommendations with reference to Shaft Speed, Lubricant Level and Pressure, Operating Temperature and other conditions.
- Physical Properties of Sealing Members.
- Specifications of Standard Seals, including Outside Diameter, Bore Diameter, Shaft Diameter, Seal Width, with tolerances on each.
- Installation Instructions.

. . . WRITE for your copy of this up-to-the-minute data.

"PERFECT" Oil Seals

CHICAGO RAWHIDE MANUFACTURING COMPANY

1310 ELSTON AVENUE • CHICAGO, ILLINOIS

64 YEARS MANUFACTURING QUALITY MECHANICAL LEATHER GOODS EXCLUSIVELY
AND NOW SIRVENE SYNTHETIC PRODUCTS

PHILADELPHIA • CLEVELAND • NEW YORK • DETROIT • BOSTON • PITTSBURGH • CINCINNATI

AIR BRIEFS

(*Continued from page* 24)

Parasuit

An English manufacturer has brought out something so clever that we can't help speak of it. We have all watched aviators waddling across the field in a clumsy suit covered with a harness holding something resembling the seat of an overstuffed chair to the sit-down of his pants. This British firm has had the good sense to make the suit and parachute harness into one decently designed garment which holds the parachute comfortably distributed over the body of the wearer, thus making a neater job and preventing the improper fastening of a harness which might leave the luckless flier some hundreds of feet below his chute by the time it opens.

Fighters

The Russians believe that there should be three types of fighters (a) the single seater of extremely high speed, (b) the slower but more maneuverable single seater and (c) the two seater. The demand for a fighter capable of acrobatics of the World War I variety even though it entail loss of speed is a direct result of lessons of the Spanish Civil War laboratory and others than the Russians might well study them.

Gliders

Every month brings more and more glider stories and where there is smoke there is fire. Most people wonder how the planes get the gliders into the air and how they are towed. It appears that the best foreign practice calls for the towing plane to be the apex of a vee and that assistance, usually in the form of stretched shock cord or some other semi-catapult device is used to give the glider a start with the plane hooking it under way or else on a normal take off. With the use of rocket take-off assistance for overloaded planes it would not be a stretch of the imagination to envisage rockets helping glider take offs.

Overhead Conveyors at The Martin Plant

(*Continued from page* 27)

angle-iron railing.

Where it sweeps down to the station the track is normally curved to a radius of 12 ft., but where the line approaches the power source on its return, where the tension on the chain is at its maximum, the radius is made 20 ft. Trays sweep into and out of stations through circular arcs of 45 deg. There is a safety button at each station, by means of which the whole system can be stopped instantly in an emergency.

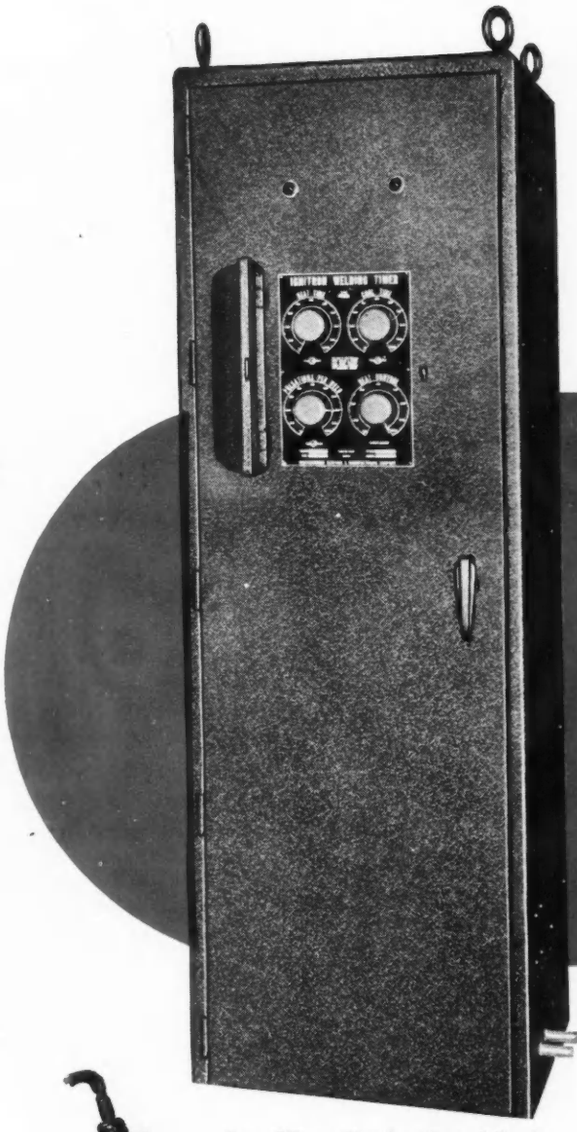
The conveyor chain consists of No. 458 rivetless, heat-treated chain, and is supported by roller trolleys spaced 32 in. apart, rolling on the lower flange of the I-beams. In the large system an automatic spring-type take-up is provided to maintain a uniform tension on the chain. There is an adjustable safety over-load device in the drive of the conveyor. In case a carrier should foul at any of the openings through which it has to pass, or if excessive tension in the chain develops for any other reason, this device opens a limit switch and shuts off current from the electric motor.

The carriers used in the system are of all-welded steel construction, 3 ft. wide, 4 ft. long, and with 4 ft. maximum clearance in the cradle. The trays are slightly dished, to better retain the material. A maximum load of 200 lb. can be carried on a tray, but it is specified that this load must be divided between two or more baskets or containers. Tray destinations are marked by a dial.

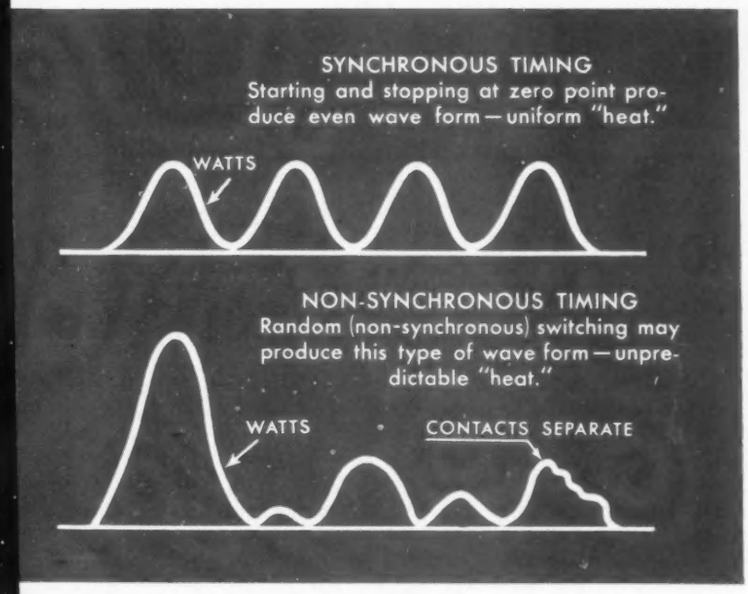
Reduce Rejects

on short-time welds...with Westinghouse

SYNCHRONOUS TIMERS



Type SX, combination timer, fully electronic. For spot, seam or pulsation welding. Where frequent changes of timing are necessary.



THE IGNITRON TUBE PIONEERED BY WESTINGHOUSE

Makes Possible Split-Second Timing

The Westinghouse development of the Ignitron tube has made it possible to make and break circuits noiselessly with split-second accuracy as many as 600 times a minute without any moving parts.

Where thin pieces or metals with critical fusion points are to be welded, random (nonsynchronous) switching is responsible for a high rate of rejects. Unpredictable transients mean unpredictable heat—burn through, warping, and even cold welds.

Westinghouse Synchronous Timers eliminate these transients—they start and stop current always on the zero point of the current wave, or later (when heat control is used). As a result, each weld is a duplicate of the preceding one because its wave form is the same.

With these Westinghouse Timers, you can mass-produce short-time welds of uniform strength and soundness. Metallurgical characteristics can be controlled (stainless steel will not lose its stainless properties) and appearance is improved by holding indentation to a minimum.

There's a Westinghouse Control that will fit your present requirements, whether it's production seam welding only, or a combination of spot, pulsation, and seam welding. Ask your Westinghouse representative for the facts about this precision electronic control. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

J-21225

Westinghouse

RESISTANCE WELDING CONTROL

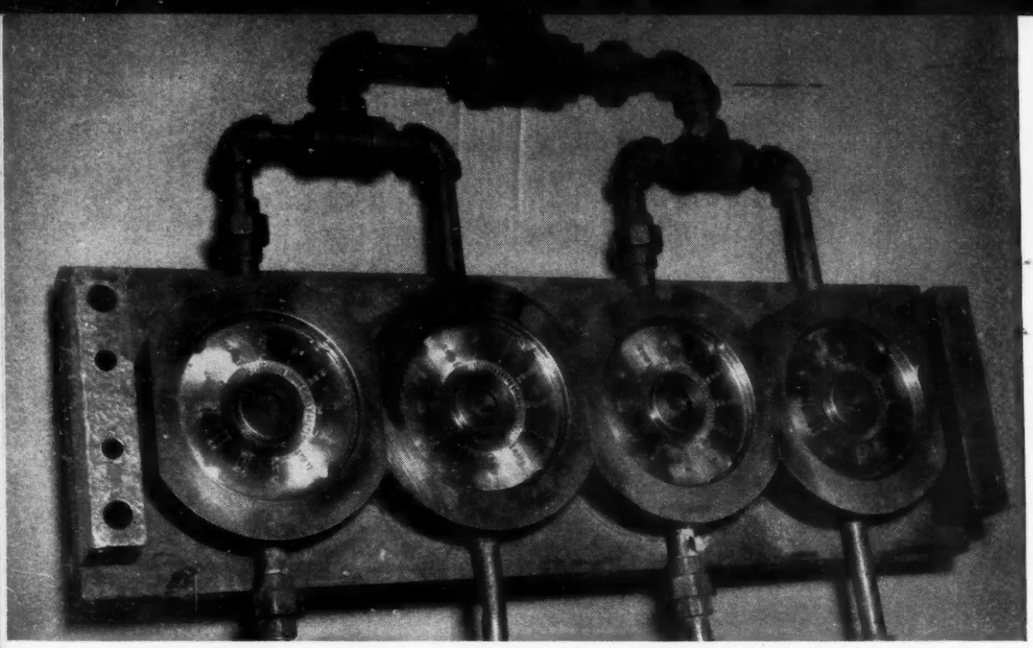


Fig. 1. Dies from which American Insulator Corp. has molded plastic faces for clocks. These tools were Vapocarb-Hump hardened and Homo Tempered.

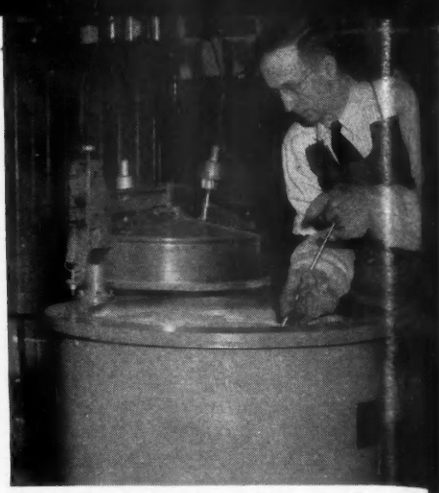


Fig. 2. Heat-treater at Homo Tempering Furnace, where forced-convection air tempers gently, accurately and quickly.

HOW AMERICAN INSULATOR CORP. "VAPOCARBS" ITS MOLDING DIES

Plastic-molding dies which have absolutely flawless surfaces are, of course, nothing new to the American Insulator Corp., of New Freedom, Pa. The production of such dies, however, took a sharp turn upward when the Company started, a few years ago, to heat-treat them by the Vapocarb-Hump hardening and Homo tempering methods.

For, the ultimate perfection of the dies had been produced by "polishing" to remove the pits created by heat-treatment. But, Vapocarb-Hump hardening, plus Homo tempering, produce no such pits. Dies remain perfectly smooth, and hours or days of polishing are saved, at a time when every hour counts.

Vapocarb-Hump and Homo Methods are easy to use. The cycles are as follows:

"Perfect-Surface" Hardening Routine

The hob for a die is absolutely bare when put into the Vapocarb-Hump Furnace (Fig. 3) for hardening.

As it heats, its temperature is recorded on the Hump Method controller's chart, (at right in Fig. 3). On the same chart, the difference between hob temperature and temperature of furnace is also recorded. These two temperatures help the heat-treater to set the controller for the correct *rate* of heating. Rate which is correct will help, later on, to prevent unexpected warp, when the tool is hardened by quenching.

At about 1200 F, the heat-treater starts Vapocarb gas into the hardening furnace. This gas forces all air out, blanketing the tool and assuring that it will leave the furnace with its engraved lines as smooth and sharp as when it entered.

Quench by the Hump

When the hob reaches its critical, a "Hump" appears on the record curve. This Hump helps the heat-treater to check his judgment of the quench point; and, since proper quench point helps make the tool strong enough and hard enough for its severe service, the Hump helps secure maximum life.

No Guesses About Tempering

After quenching, the hob is checked for hardness, and tempered to "draw the tool back" to its final hardness. Here the Homo Method (Fig. 2) heats it gently but quickly, to the exact desired point, and holds it for any desired time.

When it leaves the Homo Furnace, the hob is completely heat-treated.

Carburizing of Hobbed Dies

The dies punched with the hob (for example, the clock-faces shown above) are carburized in the Vapocarb-Hump Furnace which hardened the hob, and are tempered in the Homo Furnace. Thus one pair of furnaces does the whole heating job, on any tool steel from punch alloys to hobbing iron.

Further details of Vapocarb-Hump hardening and Homo Tempering Methods are in Catalogs T-621 and T-625, which will be sent on request.

Fig. 3. Vapocarb-Hump Hardening and Homo Tempering equipments in American Insulator's heat-treat. Controllers in background; operator is at Vapocarb-Hump Furnace. Note convenient placing of all units.

Jrl Ad ENT-0600C(47)